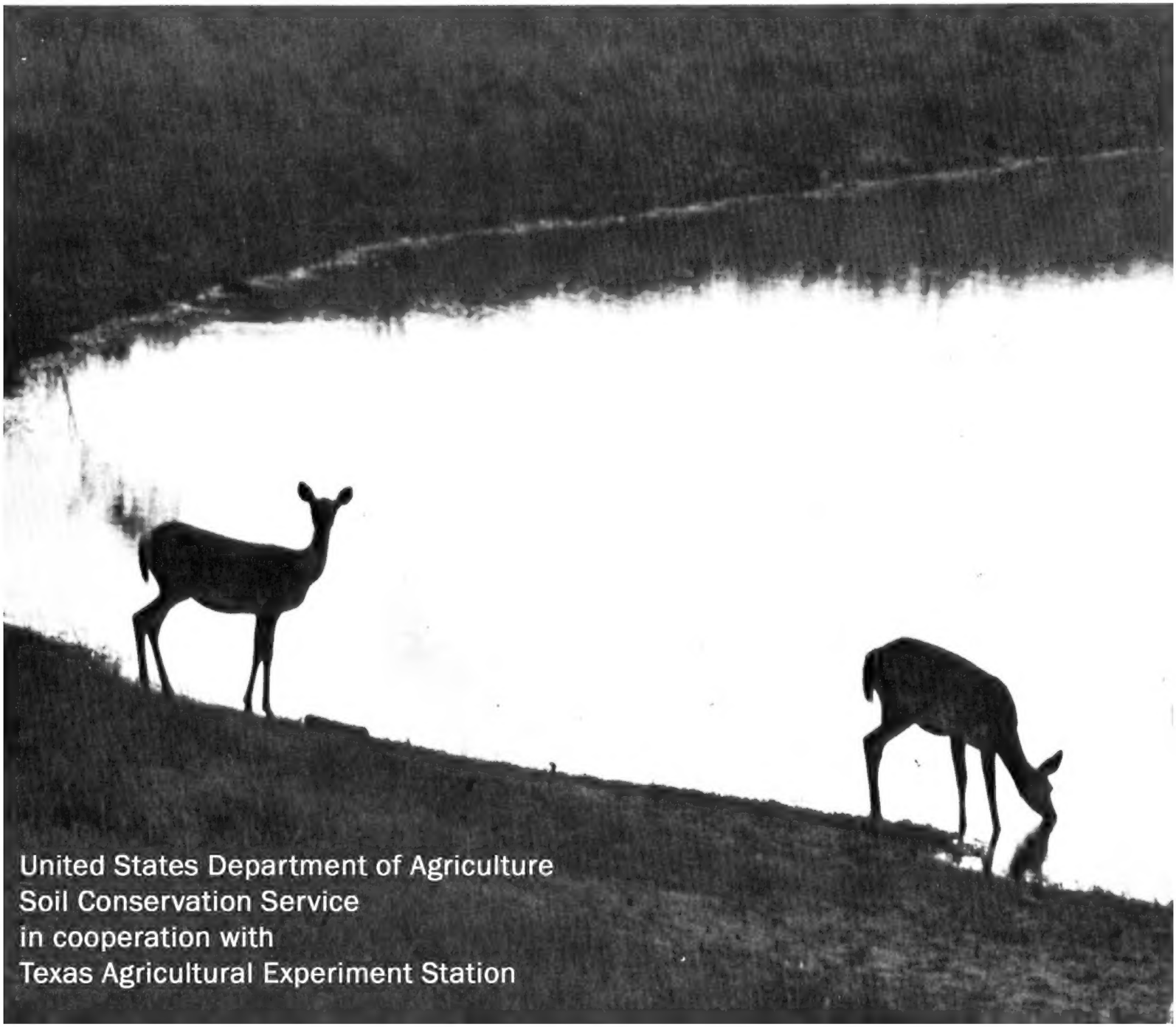
SOIL SURVEY OF

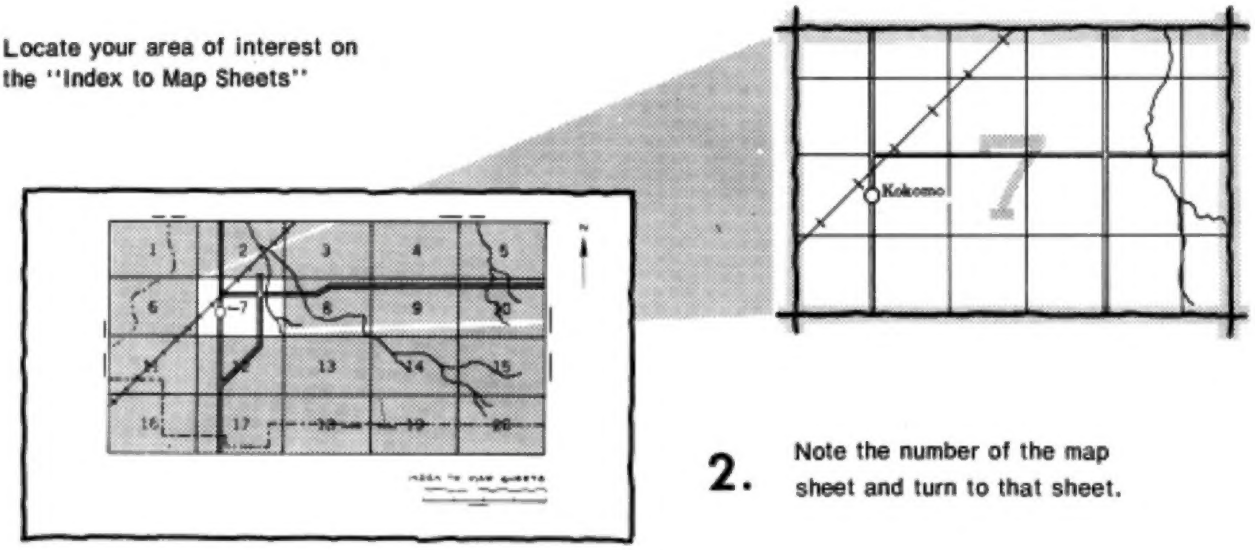
PALO PINTO COUNTY, TEXAS



United States Department of Agriculture
Soil Conservation Service
in cooperation with
Texas Agricultural Experiment Station

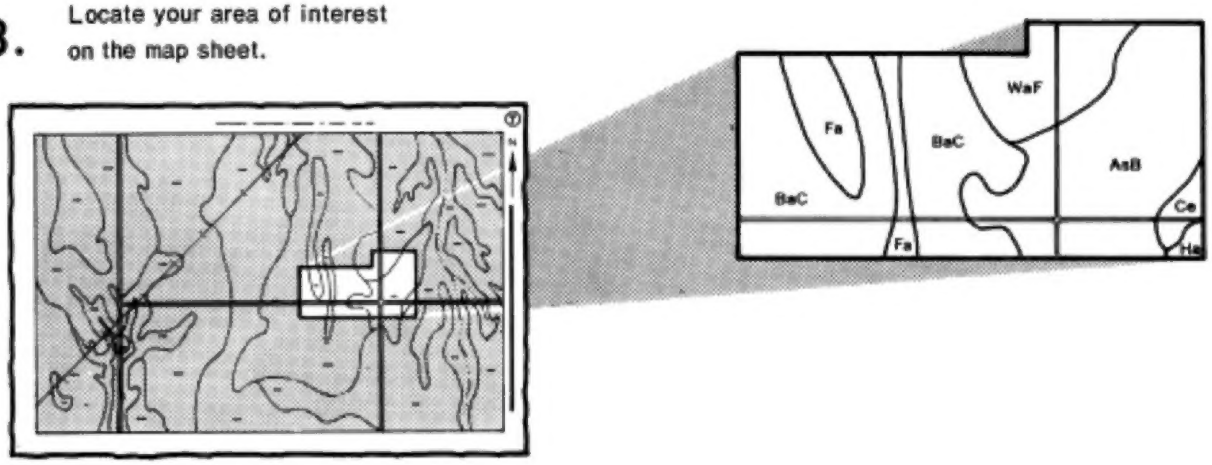
HOW TO USE

1. Locate your area of interest on the "Index to Map Sheets"

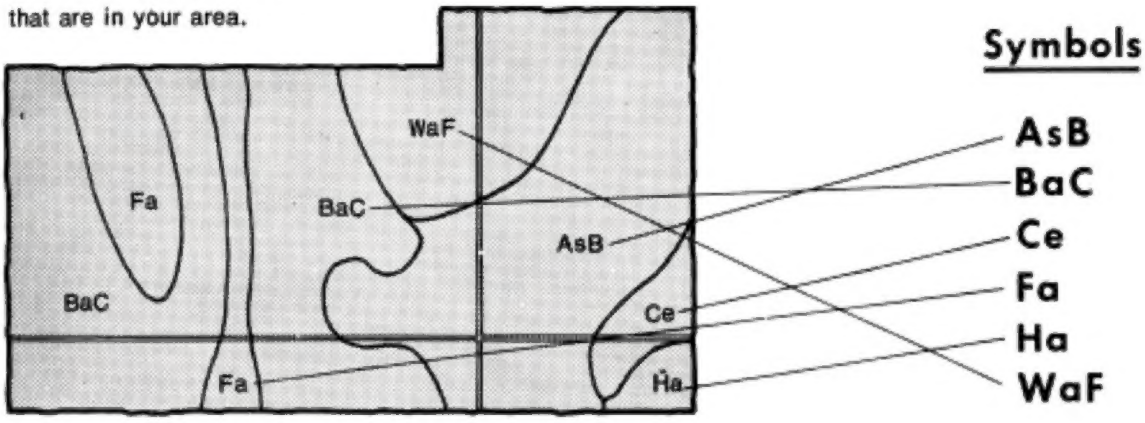


2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.

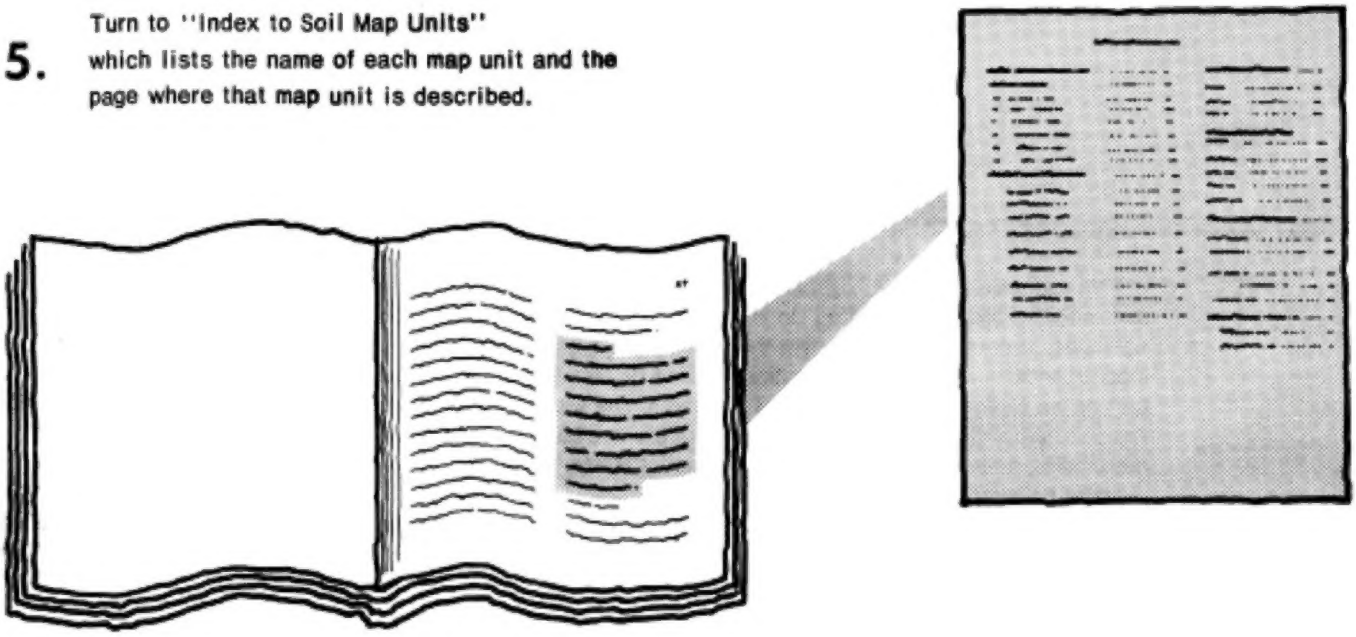


4. List the map unit symbols that are in your area.

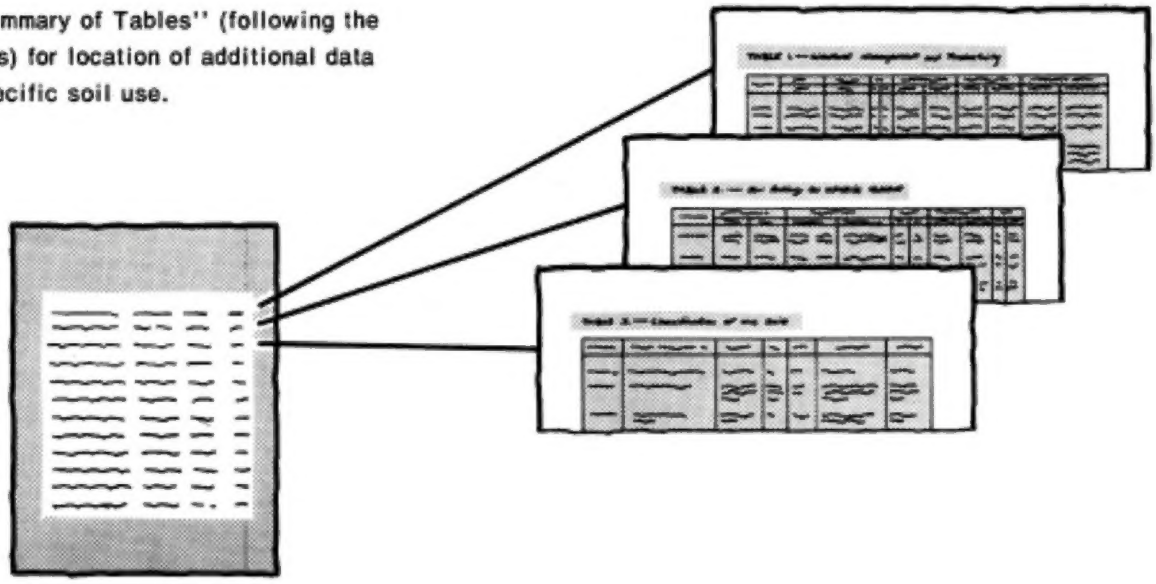


THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was performed in the period 1974-1978. Soil names and descriptions were approved in 1979. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1979. This survey was made cooperatively by the Soil Conservation Service and the Texas Agricultural Experiment Station. It is part of the technical assistance furnished to the Palo Pinto Soil and Water Conservation District.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

Cover: This pond on Truce fine sandy loam, 1 to 3 percent slopes, provides an important element of wildlife habitat for these deer.

contents

soil series

Issued August 1981

index to map units

summary of tables

foreword

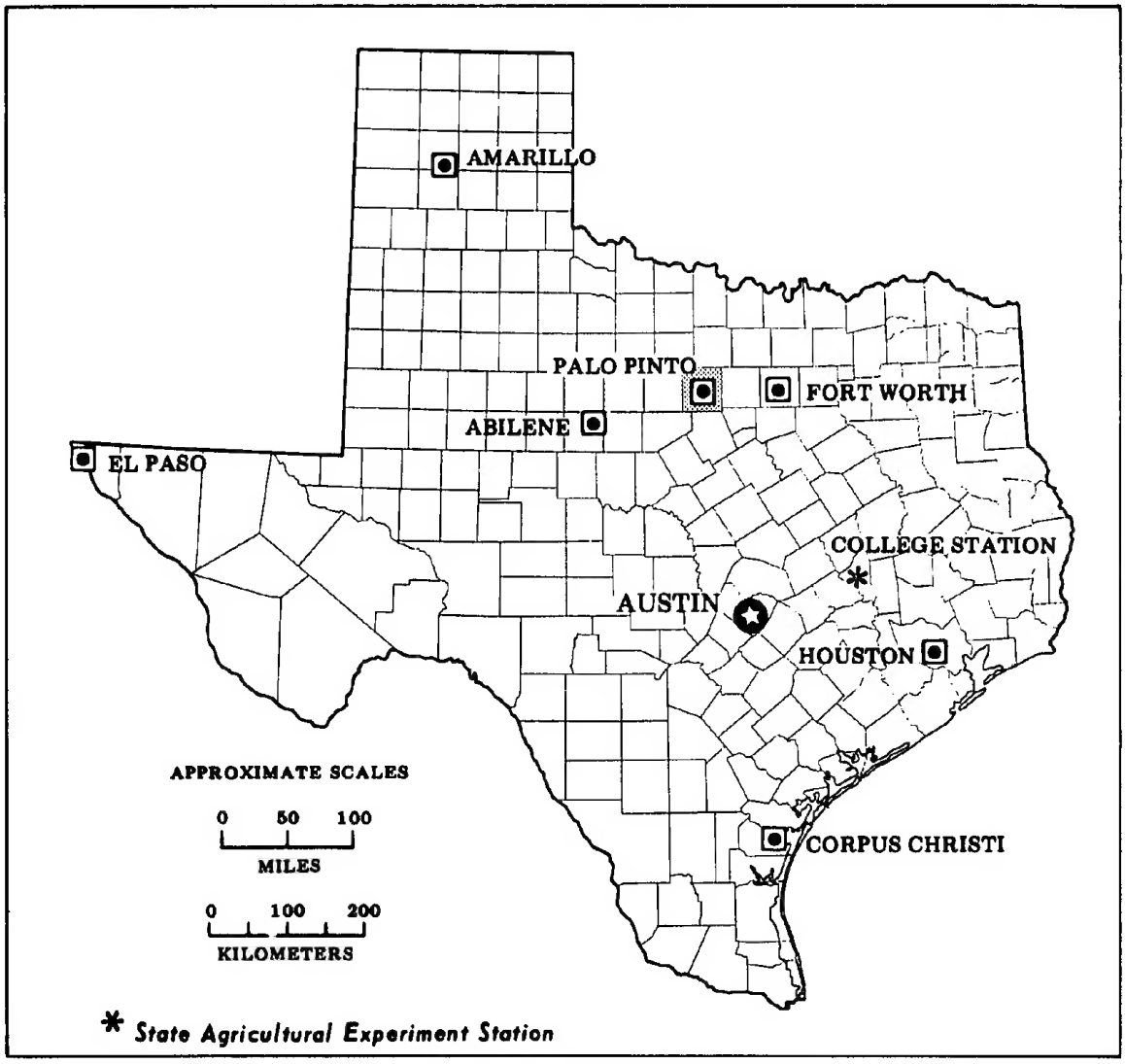
This soil survey contains information that can be used in land-planning programs in Palo Pinto County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

George C. Marks
State Conservationist
Soil Conservation Service



Location of Palo Pinto County in Texas.

soil survey of
Palo Pinto County, Texas

By Joe D. Moore, Soil Conservation Service

Soils surveyed by James M. Greenwade and Joe D. Moore
Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service
in cooperation with
Texas Agricultural Experiment Station

PALO PINTO COUNTY is located in the north-central part of Texas. It covers 985 square miles, or 630,400 acres, of which 23,680 acres is water. The bodies of water are more than 40 acres each. The county consists of gently sloping, sandy and loamy uplands in the southeastern part and hilly, clayey and loamy rangeland throughout the rest of the area.

The Brazos River and Palo Pinto Creek are the major streams that drain the survey area. Elevation ranges from about 800 to 1,450 feet.

The county has an early history of coal and oil "boom days", Indians, and outlaws.

A railroad crosses the southern part of the county from east to west. Many U.S. and state highways and farm roads link all parts of the county. An interstate highway crosses the southeastern part of the county.

Palo Pinto, the county seat, is located near the center of the county. Other cities and towns include Mineral Wells, Santo, Gordon, Mingus, Strawn, and Graford.

general nature of the survey area

This section describes settlement and population, climate, agriculture, and natural resources.

settlement and population

Palo Pinto County was created in 1856 from Bosque and Navarro Counties. It was organized in 1857 and named for a creek, Palo Pinto, which is Spanish for painted stick. The area was inhabited by Indian tribes, mainly along the Brazos River. Today, creeks and streams bear Indian names. Palo Pinto, the county seat, was first named Golconda but was changed to the county name.

In the northern part of the county, the town of Graford is located between Graham and Weatherford, the towns for which it was named. Graford, a farming and ranching center, was once used as a stop by stagecoaches enroute to Fort Belknap in the northwest, near the present site of Graham, Texas. The name Mineral Wells was given to a town in the eastern part of the county where J. A. Lynch dug the first mineral well in 1879. Many visitors have come to drink the famous mineral waters as a cure for their ills.

Early settlement consisted of ranches and farms. This trend has changed little. Urban development has not been significant. The 1880 census of the county recorded a population of 5,885, which grew to 28,962 by 1970. Approximately 18,000 people live in the city of Mineral Wells.

climate

Prepared by the National Climatic Center, Asheville, North Carolina.

Palo Pinto County is hot in summer but cool in winter when an occasional surge of cold air causes a sharp drop in otherwise mild temperatures. Rainfall is uniformly distributed throughout the year, reaching a slight peak in spring. Snowfalls are infrequent. Annual total precipitation is normally adequate for cotton, feed grains, and small grain.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Mineral Wells in the period 1955 to 1976. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 47 degrees F, and the average daily minimum temperature is 34 degrees. The lowest temperature on record, which occurred at Mineral Wells on January 23, 1966, is 4 degrees. In summer the average temperature is 83 degrees, and the average daily maximum temperature is 95 degrees. The highest recorded temperature, which

occurred at Mineral Wells on June 15, 1960, is 110 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is 31 inches. Of this, 19 inches, or 60 percent, usually falls in April through September, which includes the growing season for most crops. In 2 years out of 10, the rainfall in April through September is less than 14 inches. The heaviest 1-day rainfall during the period of record was 6.24 inches at Mineral Wells on July 27, 1962. Thunderstorms occur on about 50 days each year, and most occur in spring.

Average seasonal snowfall is 4 inches. The greatest snow depth at any one time during the period of record was 6 inches. On an average of 1 day, at least 1 inch of snow is on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 70 percent of the time possible in summer and 60 percent in winter. The prevailing wind is from the south. Average windspeed is highest, 12 miles per hour, in spring.

Tornadoes and severe thunderstorms occur occasionally. These storms are local and of short duration, and the pattern of damage is variable and spotty.

agriculture

Palo Pinto County is agriculturally oriented. According to the Conservation Needs Inventory of 1970 (*7*), approximately 85 percent of the land area was used as rangeland. Most of the county agricultural income was derived from the sale of livestock. Cropland, mainly in the southern part of the county, consists mainly of peanuts and sorghum. The acreage used as pastureland has increased as marginal cropland or brush areas are converted to improved pasture.

The enactment of the Soil Conservation District legislation in 1939 stirred the interest of many landowners in Palo Pinto County. Farmers and ranches recognized the problems of soil blowing, water erosion, overgrazing of rangeland, shortage of livestock watering facilities, and invasion of brush. The Palo Pinto Soil and Water Conservation District was organized in 1940.

The total number of farms and ranches has decreased because smaller farms and ranches have consolidated into larger commercial units.

The capabilities of the soils, the climate limitations, and present economic conditions indicate that the future economy of the county may be based on the original combination of rangeland, cropland, and pastureland.

natural resources

Soil is the most important natural resource in the county. Livestock that graze the grassland and crops that are produced on farms are the marketable products derived from the soil.

Numerous lakes, ponds, and rivers provide water for livestock and wildlife and for recreation and municipal uses.

The county has extensive mineral resources. Natural gas was first discovered in 1882 near Strawn. The first commercial oil wells were discovered in 1915. Extensive deposits of clay and shale are used by manufacturers for producing clay pipe, brick, and tile. Large amounts of stone, sand, and gravel occur in the county. They are used in the construction industry. Cedar trees, used for fence posts, are plentiful. The coal mines in the southwestern part of the county near Strawn and Mingus were closed after World War II. Some coal strip mines have begun operating again.

how this survey was made

Soil scientists made this survey to learn what soils are in the survey area, where they are, and how they can be used. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; and the kinds of rock. They dug many holes to study soil profiles. A profile is the sequence of natural layers, or horizons, in a soil. It extends from the surface down into the parent material, which has been changed very little by leaching or by plant roots.

The soil scientists recorded the characteristics of the profiles they studied and compared those profiles with others in nearby counties and in more distant places. They classified and named the soils according to nationwide uniform procedures. They drew the boundaries of the soils on aerial photographs. These photographs show trees, buildings, fields, roads, and other details that help in drawing boundaries accurately. The soil maps at the back of this publication were prepared from aerial photographs.

The areas shown on a soil map are called map units. Most map units are made up of one kind of soil. Some are made up of two or more kinds. The map units in this survey area are described under "General soil map units" and "Detailed soil map units."

While a soil survey is in progress, samples of some soils are taken for laboratory measurements and for engineering tests. All soils are field tested to determine their characteristics. Interpretations of those characteristics may be modified during the survey. Data are assembled from other sources, such as test results,

records, field experience, and state and local specialists. For example, data on crop yields under defined management are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it can be used by farmers, rangeland and woodland managers, engineers, planners, developers and builders, home buyers, and others.

general soil map units

The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit on the general soil map is a unique natural landscape. Typically, a map unit consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one unit can occur in other units but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

The soils in the survey area vary widely in their potential for major land uses. The potential of each map unit for major land uses and soil properties that limit use are indicated. Soil potential ratings are based on the practices commonly used in the survey area to overcome soil limitations. These ratings reflect the ease of overcoming the limitations. They also reflect the problems that will persist even if such practices are used.

Each map unit is rated for cropland, pastureland, rangeland, and urban uses. Cropland is extensive in the survey area. Patureland refers to land on which improved grasses, such as bermudagrass and kleingrass, are grown. Rangeland refers to land managed for native range plants including grasses, forbs, and woody plants. Urban uses include residential, commercial, and industrial developments.

soil descriptions

1. Palopinto-Set-Hensley

Shallow and deep, nearly level to steep, loamy and clayey, stony soils; on uplands

This map unit is on broad limestone capped cuestas, or ridges, and steep stony escarpments surrounding deep, narrow valleys (fig. 1). These areas are known locally as "live oak country". Live oak is the dominant tree species, including invading cedar and mesquite. Slopes range from 0 to 40 percent. The map unit makes up about 39 percent of the county. It is about 24 percent Palopinto soils, 23 percent Set soils, 21 percent is Hensley soils, and 32 percent other soils.

The gently sloping to steep Palopinto soils are on ridgetops and steep escarpments. The surface layer typically is moderately alkaline, dark grayish brown extremely stony clay loam about 12 inches thick. Below that is hard fractured limestone bedrock.

The gently sloping to steep Set soils are mainly on steep, stony escarpments and long slopes leading into valleys. These soils typically are moderately alkaline, brownish clay and silty clay to a depth of about 38 inches. Below that, to a depth of 44 inches, is moderately alkaline, brownish silty clay loam. The underlying layer is grayish shaly clay to a depth of 60 inches.

The nearly level to gently sloping Hensley soils are mainly on broad ridgetops. The surface layer typically is neutral, reddish brown very stony clay loam about 6 inches thick. From a depth of 6 to 15 inches is neutral, dark reddish brown clay loam. Below that is limestone bedrock.

Other soils in this map unit are the Apalo, Bastrop, Bosque, Decordova, Eufaula, Frio, Minwells, and Santo soils on flood plains and stream terraces; Leeray and Lindy soils on broad, gently sloping uplands; Owens soils on steep, stony south-facing slopes; and Velow soils on slopes near drainageways.

This mapped area is moderately well suited to use as rangeland. Stoniness, soil depth, and very low available water capacity are major limitations. Proper grazing with adequate rest periods and brush management are needed. Potential is high for wildlife habitat, especially for deer, because of the abundance of herbaceous and woody vegetation. Management of the food supply is very important for wildlife.

The soils in this map unit are poorly suited to use as cropland, pastureland, and urban uses because of slope, stoniness, and depth to rock.

2. Bonti-Truce-Shatruce

Moderately deep and deep, gently sloping to steep, loamy, stony, and bouldery soils; on uplands

This map unit is on gently sloping sandstone capped cuestas, or ridges; steep escarpments; and in gently sloping, narrow valleys (fig. 2). This area is often referred to locally as the "post oak country". Post oak is the dominant tree species. Slopes range from 1 to 40

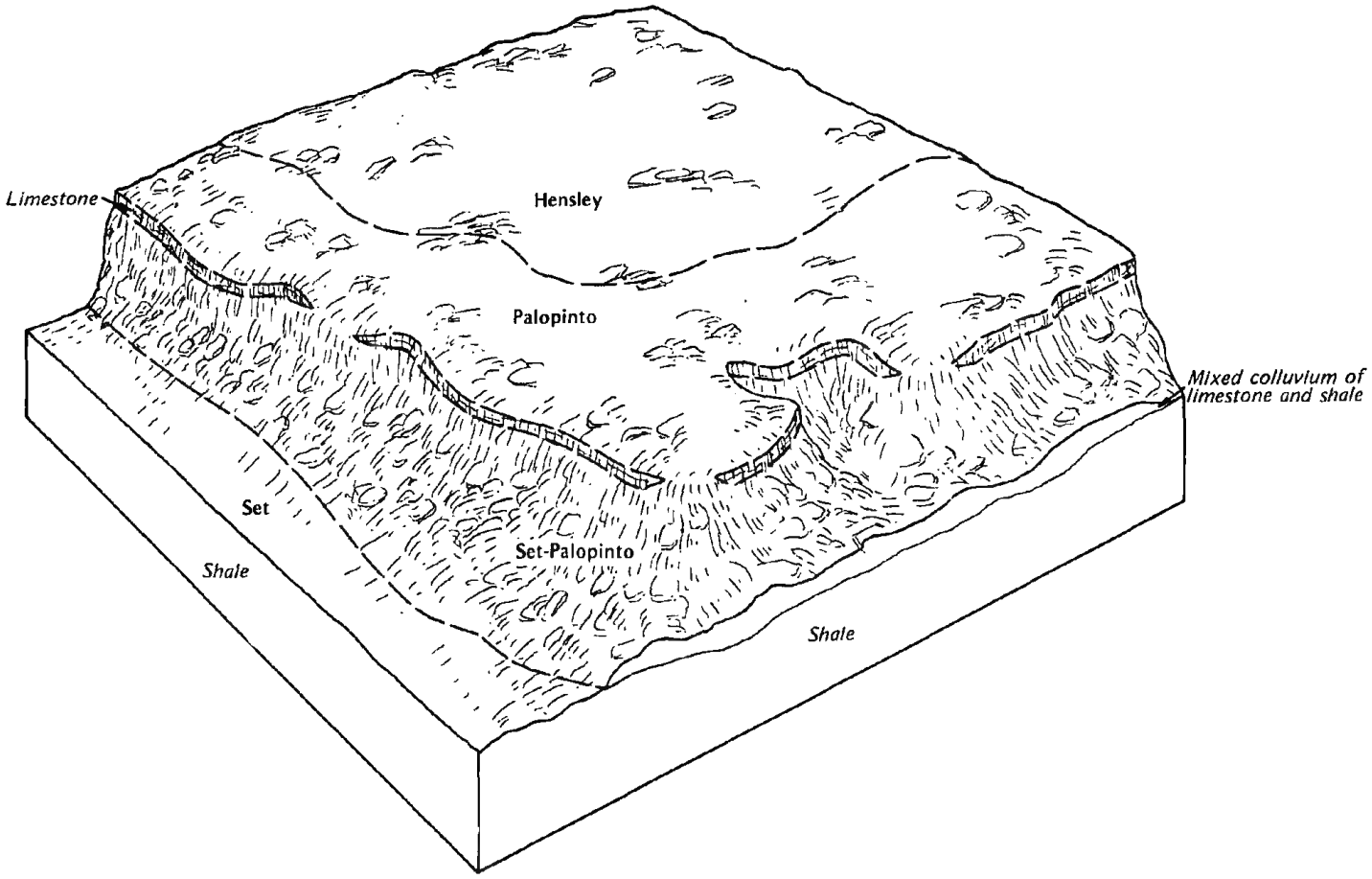


Figure 1.—Typical pattern of soils in the Palopinto-Set-Hensley map unit.

percent. The map unit makes up about 31 percent of the county. It is about 22 percent Bonti soils, 18 percent Truce soils, 10 percent Shatruce soils, and 50 percent other soils.

The gently sloping to sloping Bonti soils generally are on ridgetops. Sandstone fragments litter the surface. The surface layer typically is neutral, very dark grayish brown very stony fine sandy loam about 2 inches thick. The next layer is slightly acid, light yellowish brown fine sandy loam about 3 inches thick. From a depth of 5 to 24 inches is red clay that ranges from medium acid to strongly acid. Below that is brownish yellow, strongly cemented sandstone bedrock.

The gently sloping to steep Truce soils are mainly on convex ridges and escarpments. The surface layer typically is slightly acid, brownish to pinkish fine sandy loam about 7 inches thick. Below that to a depth of 48 inches is neutral clay that is reddish in the upper part, brownish in the middle part, and yellowish in the lower part. The underlying layer from a depth of 48 to 60 inches is moderately alkaline shaly clay.

The strongly sloping to steep Shatruce soils are on very bouldery escarpments. The surface layer typically is neutral, brownish very bouldery sandy loam about 2 inches thick. The next layer to a depth of 14 inches is slightly acid, brownish sandy loam. From a depth of 14 to 34 inches is very strongly acid clay that is reddish in the upper part and yellowish in the lower part. The underlying layer to a depth of 60 inches is strongly acid shaly clay.

Other soils in this map unit are the Bosque, Frio, and Santo soils on flood plains; Blanket and May soils on low stream terraces; Minwells soils on high stream terraces; Hassee and Thurber soils in low-lying flats; and Chaney, Shavash, and Vashti soils on broad uplands.

This mapped area is moderately well suited to use as rangeland. Soil depth, available water capacity, stones and boulders, and rapid runoff are major soil limitations. Proper grazing with adequate rest periods and brush management are needed. Potential as wildlife habitat for quail, deer, turkey, or exotic animals can be improved by proper management of herbaceous and woody

vegetation. Extensive removal of woody plants is detrimental to the wildlife habitat.

The soils in this map unit are dominantly moderately well suited to use as pastureland and cropland and poorly suited to urban uses. Stones, boulders, and steep slopes in some areas are limitations.

3. Leeray

Deep, nearly level to gently sloping, clayey soils; on uplands

This map unit is in broad, shallow valleys in uplands. The mapped area is locally known as the "flat country," where native vegetation is dominantly short grasses and invading mesquite trees. Slopes range from 0 to 5 percent. The map unit makes up about 10 percent of the county. It is about 52 percent Leeray soils and 48 percent other soils.

The nearly level to gently sloping Leeray soils are in "hog wallows," depressions, or on low mounds. These soils typically are moderately alkaline to a depth of about 60 inches. The upper part is dark grayish brown, the middle part is grayish brown, and the lower part is light olive brown. These soils crack when dry because of high shrink-swell potential.

Other soils in the map unit are Bonti, Exray, Owens, and Truce soils on sandstone ridges and hills; Bosque, Frio, and Santo soils on flood plains; Minwells soils on stream terraces; Hassee and Thurber soils in depressed areas; and Hensley, Lindy, Set, and Wichita soils on limestone uplands.

Most of the soils in this unit are used as rangeland. They are well suited to native forage production. Most of

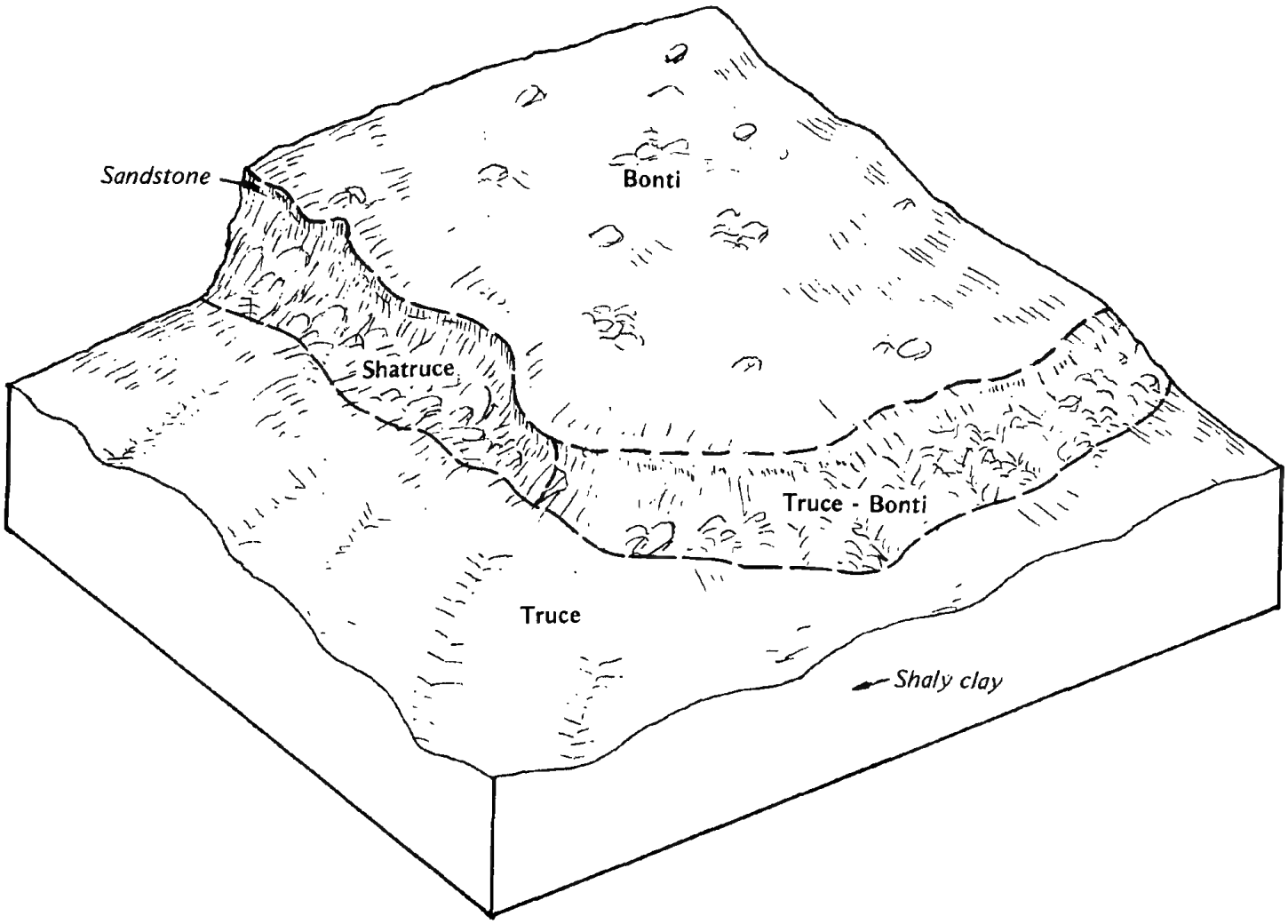


Figure 2.—Typical pattern of soils in the Bonti-Truce-Shatruce map unit.

these soils have a dense, very slowly permeable subsoil that restricts root and water penetration and causes the soils to be droughty. Because of this limitation, the short grasses are grown. Proper grazing with adequate rest periods and brush management are conservation practices necessary for range improvement.

The potential for wildlife habitat is medium. Deer and turkey inhabit this mapped area. The scarcity of desirable woody plants, however, limits the food and cover available for the optimal habitat. Doves use the brush for nesting.

This mapped area is moderately well suited to use as cropland. Small grain, forage sorghum, and cotton are the major crops. Large areas of this unit are suited to cropland and the use of heavy farm equipment. Water erosion is a hazard in most cropped areas.

The soils in this unit are moderately well suited to pasture. Kleingrass is a suitable species. These soils are poorly suited to urban uses. The shrink-swell potential is a limitation that makes special design in construction necessary. Also the clayey subsoil is a limitation for septic tank filter fields.

4. Bastrop-Apalo

Deep, gently sloping to sloping, sandy and loamy soils; on stream terraces

This map unit is on stream terraces that are mainly on the inside of the numerous bends in the Brazos River Valley (fig. 3). Slopes range from 1 to 8 percent. The map unit makes up about 5 percent of the county. It is about 32 percent Bastrop soils, 20 percent Apalo soils, and 48 percent other soils.

Bastrop soils are mainly on the second terrace, which is generally 50 to 60 feet above the Brazos River channel. Typically, the surface layer is brownish fine sandy loam about 13 inches thick. From a depth of 13 to 80 inches is sandy clay loam that is brownish in the upper part and reddish in the lower part. These soils are slightly acid in the upper part, grading to moderately alkaline in the lower part.

Apalo soils are on the first, or lowest, terrace about 40 feet above the river channel. To a depth about 52 inches, these soils typically are neutral, very fine sandy loam that is brownish in the upper part and reddish in the lower part. From a depth of 52 to 80 inches is moderately alkaline, reddish loam.

Other soils in this unit are Decordova and Eufaula soils on the higher, sandy terraces at the larger bends in the river, generally 60 to 70 feet above the river channel; Minwells soils on terraces about 150 feet above the river channel; Set soils on limestone escarpments; Bonti and Truce soils on sandstone escarpments; and Yahola and Gaddy soils on flood plains adjacent to the river channel.

Most of the soils in this unit are used as pastureland. They are well suited to pasture. Coastal bermudagrass and lovegrass are the major grasses. Proper grazing,

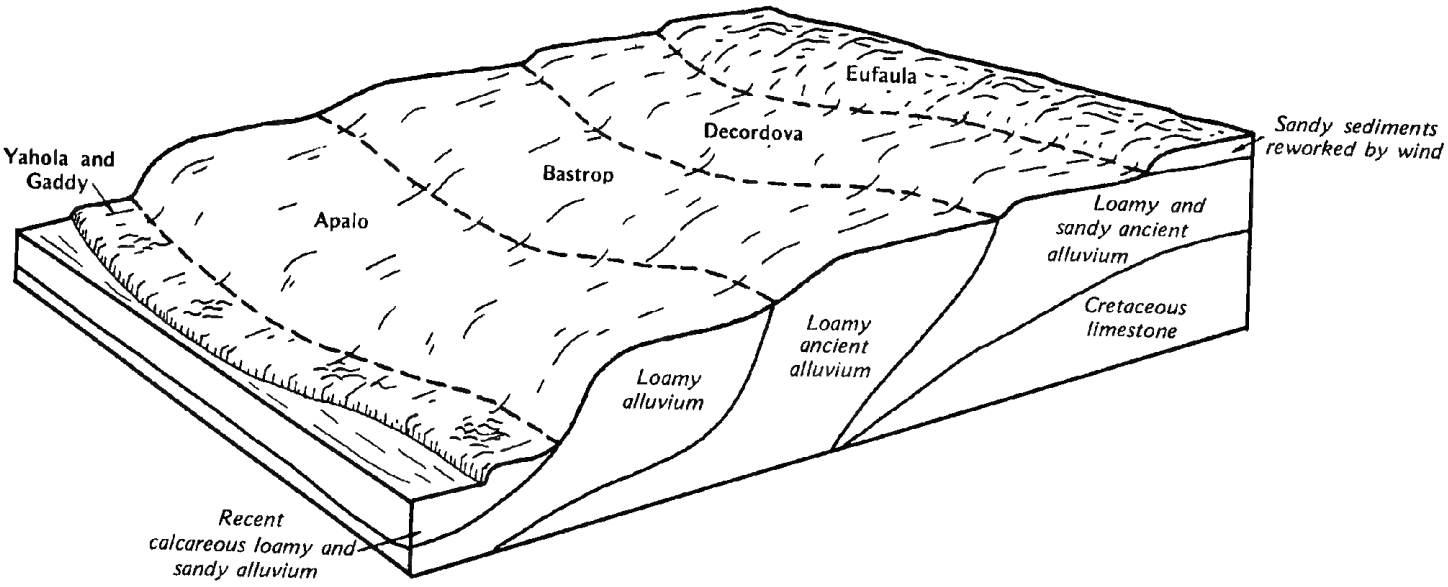


Figure 3.—Typical pattern of soils in the Bastrop-Apalo map unit.

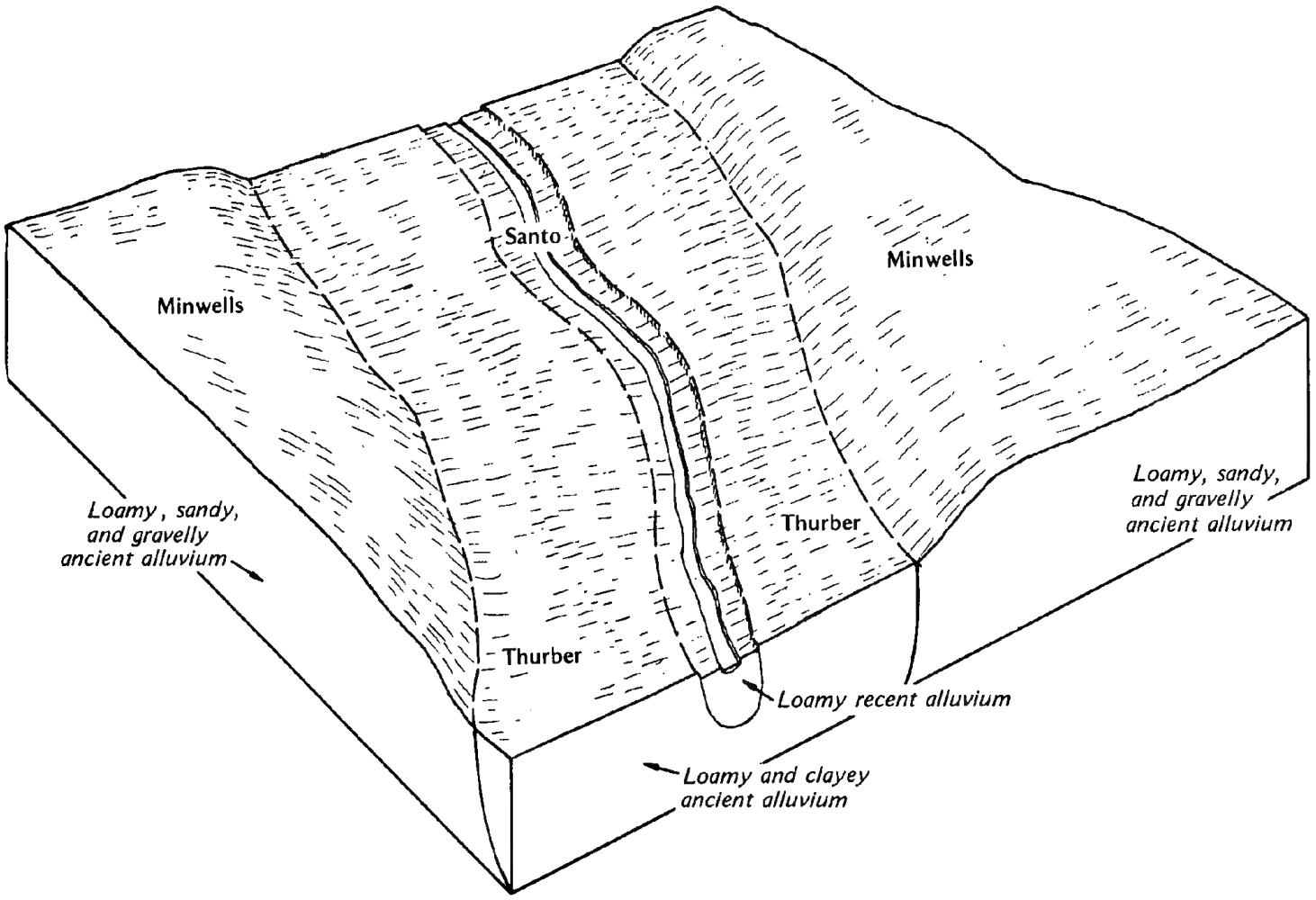


Figure 4.—Typical pattern of soils in the Minwells-Thurber map unit.

adequate rest periods, and brush management are needed. Gopher control is also needed in many areas.

This mapped area is moderately well suited to use as cropland. Peanuts and grain sorghum are the main crops. Returning crop residue to the soil helps to control soil blowing and water erosion.

The soils in this unit are well suited to use as rangeland. Controlled grazing with adequate rest periods and brush management are necessary conservation practices.

The potential is high for wildlife habitat. Deer and turkey use the woody vegetation for food, cover, and protection.

This mapped area is well suited to urban uses.

5. Minwells-Thurber

Deep, nearly level to gently sloping, loamy soils; on stream terraces and uplands

This map unit is in valleys and on stream terraces (fig. 4). Slope ranges from 0 to 5 percent. The map unit makes up about 4 percent of the county. It is about 31 percent Minwells soils, 29 percent Thurber soils, and 40 percent other soils.

Minwells soils are generally on stream terraces. The surface layer typically is brownish fine sandy loam about 6 inches thick. The next layer to a depth of 31 inches is clay that is brownish in the upper part and reddish in the lower part. From a depth of 31 to 71 inches is reddish clay loam that grades to sandy clay loam in the lower part. From a depth of 71 to 80 inches is reddish very gravelly sand. These soils typically are slightly acid in the upper part and moderately alkaline in the lower part.

Thurber soils are mostly in upland valleys. The surface layer typically is mildly alkaline, grayish brown clay loam

about 8 inches thick. From a depth of 8 to 72 inches is clay that is mildly alkaline and brownish in the upper part and moderately alkaline and grayish in the lower part.

Other soils in this map unit are Bonti, Truce, Owens, and Set soils on escarpments; Bosque, Frio, and Santo soils on flood plains; Bastrop, May, and Velow soils on low stream terraces; and Hassee, Leeray, and Wichita soils which are intermingled with Thurber soils.

This mapped area is mainly used as rangeland. It is well suited to native forage. The hazard of water erosion is the main limitation. Proper grazing with adequate rest periods and brush clearing in regular patterns are needed. Potential is high for wildlife habitat. Herbaceous and woody plants provide food and cover for wildlife. Excessive grazing reduces the potential for supporting wildlife.

The soils in this map unit are moderately well suited to use as cropland. Small grain and forage sorghum are adapted to these soils. Most of the fields are small, and the heavier farm machinery cannot easily be managed. Water erosion is a hazard on most cultivated areas. The tendency of these soils to become droughty is a limitation.

This mapped area is well suited to pasture. Coastal bermudagrass and kleingrass are the major pasture grasses.

The soils in this unit are moderately well suited to most urban uses. Shrink-swell potential and the clayey layers that restrict water intake are the main limitations in places.

6. Bosque-Santo

Deep, nearly level to gently sloping, loamy soils; on flood plains

This map unit is mainly on flood plains of streams in the southern part of the county. The map unit makes up about 4 percent of the county. It is about 41 percent Bosque soils, 31 percent Santo soils, and 28 percent other soils.

Bosque soils generally are on the widest part of the flood plain and are occasionally flooded. They typically are moderately alkaline, brownish clay loam to a depth of 60 inches or more.

Santo soils are on the more narrow flood plains and are frequently flooded. These soils are stratified, loamy, and moderately alkaline. The surface layer typically is brownish fine sandy loam about 8 inches thick. From a depth of 8 to 12 inches is pale brown loam. Below that to a depth of 36 inches is pale brown fine sandy loam. From a depth of 36 to 44 inches is very pale brown loamy fine sand, and from a depth of 44 to 80 inches is brown fine sandy loam that has thin strata of loamy fine sand.

Other soils in this map unit are Frio, May, Minwells, and Velow soils on flood plains and on low terraces adjacent to the flood plains.

Most of the soils in this unit are used as pastureland and are well suited to this use. Coastal bermudagrass is the major grass. Pecan trees are well suited to these soils. Cultivated crops are well suited to the Bosque soils that are occasionally flooded and are poorly suited to the Santos soils that are frequently flooded.

This mapped area is well suited to use as rangeland. Proper grazing with adequate rest periods and brush management are needed. These bottom land areas have high potential for wildlife habitat. Large trees and understory vegetation provide excellent food and cover for many kinds of wildlife, including deer and turkey.

The soils in this map unit are poorly suited to urban uses. Flooding is the main limitation.

7. Chaney-Windthorst-Vashti

Deep and moderately deep, gently sloping, sandy and loamy soils; on uplands

This map unit is on uplands. Slopes range from 1 to 3 percent. The map unit makes up about 3 percent of the county. It is about 23 percent Chaney soils, 21 percent Windthorst soils, 16 percent Vashti soils, and 40 percent other soils.

Chaney soils typically have a slightly acid, brownish loamy fine sand surface layer about 16 inches thick. From a depth of 16 to 60 inches is clay or sandy clay mottled in shades of red, yellow, brown, and gray. It is slightly acid in the upper part and moderately alkaline in the lower part.

Windthorst soils typically have a slightly acid, brownish fine sandy loam surface layer about 10 inches thick. Below that to a depth of 60 inches is medium acid, reddish clay that is stratified with fine sandy loam in the lower part.

Vashti soils typically have a slightly acid, brownish loamy fine sand surface layer about 16 inches thick. From a depth of 16 to 34 inches is slightly acid sandy clay loam that is brownish with reddish mottles in the upper part and yellowish with reddish mottles in the lower part. Below that, at a depth of 34 inches, is sandstone bedrock.

Other soils in this unit are Blanket, Hassee, Santo, Thurber, and Velow soils on flood plains and foot slopes and in depressions. Also in this unit are loamy Bonti soils and sandy Demona and Patilo soils on ridges.

Most of the soils in this unit are used as pastureland. They are well suited to this use. Coastal bermudagrass and lovegrass are the major grasses.

This mapped area is well suited to use as cropland. Peanuts and grain sorghum are the main crops. Soil blowing is a hazard.

These soils are well suited to use as rangeland. Proper grazing with adequate rest periods and brush control in patterns are needed. Potential for quail and dove habitat is high because of the herbaceous and woody vegetation.

The soils in this map unit are moderately well suited to urban uses. Shrink-swell potential and slow permeability are limitations.

detailed soil map units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and management of the soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Bastrop fine sandy loam, 1 to 3 percent slopes, is one of several phases in the Bastrop series.

Some map units are made up of two or more major soils. These map units are called soil complexes, soil associations, or undifferentiated groups.

A *soil complex* consists of two or more soils in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Bonti-Exray complex, very stony, 1 to 8 percent slopes is an example.

A *soil association* is made up of two or more geographically associated soils that are shown as one unit on the maps. Because of present or anticipated soil uses in the survey area, it was not considered practical or necessary to map the soils separately. The pattern and relative proportion of the soils are somewhat similar. There are no soil associations in this survey.

An *undifferentiated group* is made up of two or more soils that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils in a mapped area are not uniform. An area can be made up of only one of the major soils, or it can be made up of all of them. Yahola and Gaddy soils, occasionally flooded, is an undifferentiated group in this survey area.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Dumps, mine is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

soil descriptions

1—Apalo very fine sandy loam, 1 to 3 percent slopes. This deep, well drained, gently sloping soil is on stream terraces that are, in most places, the first terrace, or bench, above the flood plain of the Brazos River (fig. 5). Surfaces are plane. Areas are long and range from 200 to 2,000 feet in width. They range from 30 to 300 acres.

Typically, the surface layer is neutral, reddish brown very fine sandy loam about 19 inches thick. Below that, to a depth 52 inches, is neutral, yellowish red very fine sandy loam. From a depth of 52 to 80 inches is moderately alkaline, yellowish red loam.

Permeability is moderate, and available water capacity is high. The soil can be worked well throughout a wide range of moisture conditions. Runoff is slow. The hazards of water erosion and soil blowing are moderate.

Figure 5.—This bend of the Brazos River is in an area of Yahola-Gaddy soils, occasionally flooded, where pecan trees grow. Apalo soils are on the first bench above the trees.

The root zone is deep and easily penetrated by plant roots (fig. 6). This soil responds well to fertilization.

Included with this soil in mapping are small areas of Bastrop, Decordova, and Minwells soils on low ridges. Also included are some areas of nearly level Apalo soils, areas of Apalo soils that have 3 to 5 percent slopes, and soils that have visible calcium carbonate above a depth of 28 inches. Along lower slopes near the edge of flood plains are small areas of Yahola and Gaddy soils that are closely similar. These areas are 5 to 20 acres and make up 5 to 20 percent of most mapped areas. The contrasting Minwells soils make up less than 5 percent of any mapped area.

This Apalo soil is mainly used as pastureland and is well suited to this use. Bermudagrass, kleingrass, and lovegrass are the main grasses.

This soil is also well suited to use as cropland. Sorghum, small grain, and peanuts are major crops. Terraces and contour farming help to control erosion. Residue left on the surface reduces runoff and maintains productivity. Gophers and moles should be controlled at times because they thrive in areas of this soil.

This soil is well suited to use as rangeland. The potential plant community is a post oak savannah with an understory of tall and mid grasses. The predominant plants are—

- little bluestem—30 percent
- big bluestem and sand bluestem—10 percent
- indiangrass—10 percent
- sideoats grama—10 percent
- forbs, such as yellow neptunia, scurfpea, western ragweed, Engelmann-daisy, dotted gayfeather, bundleflower, dalea, and prairie-clover—10 percent
- post oak—10 percent.

Other important plants are—

- cane and silver bluestem—5 percent
- Scribner panicum—5 percent
- Texas wintergrass—5 percent
- Arizona cottontop and sand lovegrass—5 percent
- small amounts of blackjack oak, elm, pricklyash, bumelia, hackberry, sumac, live oak, elbowbush, greenbrier, and plums.

Figure 6.—Profile of Apalo, very fine sandy loam, 1 to 3 percent slopes, with excellent root penetration. Depths are shown in feet.

Big bluestem, indiangrass, switchgrass, and sand lovegrass are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. They are replaced by little bluestem and sideoats grama, which, if overgrazing continues, can also be grazed out. Silver bluestem, hooded windmillgrass, and hairy grama would then increase. Further heavy grazing causes an invasion of threeawn, dropseed, red lovegrass, annual grasses, skunkbush sumac, and post oak. Mesquite, juniper, and catclaw can eventually take over and shade out most grasses.

Potential for wildlife habitat is good. This area is inhabited by deer, dove, quail, squirrels, and turkeys. Several of the woody plants, forbs, and grasses provide good cover, browse, mast, and seeds for game birds and animals.

The Apalo soil is well suited to most urban and recreation uses.

This soil is in capability subclass IIe and the Sandy Loam range site.

2—Apalo very fine sandy loam, 3 to 5 percent slopes. This deep, well drained, gently sloping soil is on convex terraces above flood plains of the Brazos River. Areas are elongated and follow the contour of the flood plains and associated uplands. Areas range from 15 to 100 acres.

Typically, the surface layer is slightly acid, brown very fine sandy loam about 12 inches thick. Below that, to a depth of 30 inches, is slightly acid, reddish brown very fine sandy loam. From a depth of 30 to 45 inches is mildly alkaline, yellowish red very fine sandy loam. The underlying layer is moderately alkaline, reddish yellow very fine sandy loam to a depth of 60 inches.

Permeability is moderate, and available water capacity is medium. Runoff is medium, and the hazard of water erosion is severe. The hazard of soil blowing is moderate. The soil can be worked well throughout a wide range of moisture conditions. The root zone is deep and easily penetrated by plant roots. This soil responds to fertilization.

Included with this soil in mapping are small areas of Apalo soils that have 5 to 8 percent slopes. Small areas of Bastrop, Decordova, and Minwells soils are on low ridges. Also included in a few areas is a soil similar to the Apalo soil except the depth to carbonates is less than 28 inches. On lower slopes are small areas of Gaddy and Yahola soils that are similar. These soils are 5 to 10 acres and make up 5 to 20 percent of most areas.

This Apalo soil is dominantly used as pastureland and is well suited to this use. Bermudagrass, kleingrass, and lovegrass are the main pasture grasses. The soil is moderately well suited to use as cropland. Using terraces and contour cultivation help to control erosion. Leaving plant residue on the surface helps to reduce runoff and maintain productivity.

This soil is well suited to use as rangeland. The potential plant community is a post oak savannah with an understory of tall and mid grasses. The predominant plants are—

- little bluestem—30 percent
- big bluestem and sand bluestem—10 percent
- indiangrass—10 percent
- sideoats grama—10 percent
- forbs, such as yellow neptunia, scurfpea, western ragweed, Engelmann-daisy, dotted gayfeather,

bundleflower, dalea, and prairie-clover—10 percent
- post oak—10 percent.

Other important plants are—
- cane bluestem and silver bluestem—5 percent
- Scribner panicum—5 percent
- Texas wintergrass—5 percent
- Arizona cottontop and sand lovegrass—5 percent
- small amounts of blackjack oak, elm, pricklyash, bumelia, hackberry, sumac, live oak, elbowbush, greenbrier, and plums.

Big bluestem, indiangrass, switchgrass, and sand lovegrass are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. They are replaced by little bluestem and sideoats grama, which, if overgrazing continues, can also be grazed out. Silver bluestem, hooded windmillgrass, and hairy grama would then increase. Further heavy grazing causes an invasion of threeawn, dropseed, red lovegrass, annual grasses, skunkbush sumac, and post oak. Mesquite, juniper, and catclaw can eventually take over and shade out most grasses.

Potential for wildlife habitat is good. This area is inhabited by deer, dove, quail, squirrels, and turkeys. Several of the woody plants, forbs, and grasses provide good cover, browse, mast, and seeds for game birds and animals.

The Apalo soil is well suited to most urban and recreation uses.

This soil is in capability subclass IIIe and the Sandy Loam range site.

3—Apalo very fine sandy loam, 5 to 8 percent slopes. This deep, well drained, sloping soil is on terraces along the Brazos River. Areas are elongated, narrow, and sharply sloping. They parallel the river. These convex areas range from 15 to 100 acres and in some places are more than a mile long.

Typically, the surface layer is neutral, brown very fine sandy loam about 8 inches thick. From a depth of 8 to 30 inches is mildly alkaline, reddish brown very fine sandy loam. Below that, to a depth of 42 inches, is mildly alkaline, yellowish red very fine sandy loam. The underlying layer to a depth of 60 inches is moderately alkaline, reddish yellow very fine sandy loam.

Permeability is moderate, and available water capacity is medium. Runoff is rapid. The hazard of water erosion is severe, and the hazard of soil blowing is moderate. The soil can be worked well throughout a wide range of moisture conditions. The root zone is deep and easily penetrated by plant roots. This soil responds well to fertilization.

Included with this soil in mapping are small areas of less sloping Apalo soils. On lower slopes are small areas of Gaddy and Yahola soils. These included soils are less than 15 acres and together make up less than 15 percent of any mapped area.

This Apalo soil is mainly used as pastureland and is well suited to this use. Bermudagrass, lovegrass, and kleingrass are the major grasses.

Slope makes this soil poorly suited to cropland. Forage sorghum and small grain are grown in some areas. Returning crop residue to the soil helps to reduce runoff that causes erosion and maintain soil productivity.

This soil is well suited to use as rangeland. The potential plant community is a post oak savannah with an understory of tall and mid grasses. The predominant plants are—
- little bluestem—30 percent
- big bluestem and sand bluestem—10 percent
- indiangrass—10 percent
- sideoats grama—10 percent
- forbs, such as yellow neptunia, scurfpea, western ragweed, Engelmann-daisy, dotted gayfeather, bundleflower, dalea, and prairie-clover—10 percent
- post oak—10 percent.

Other important plants are—
- cane bluestem and silver bluestem—5 percent
- Scribner panicum—5 percent
- Texas wintergrass—5 percent
- Arizona cottontop and sand lovegrass—5 percent
- small amounts of blackjack oak, elm, pricklyash, bumelia, hackberry, sumac, live oak, elbowbush, greenbrier, and plums.

Big bluestem, indiangrass, switchgrass, and sand lovegrass are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. They are replaced by little bluestem and sideoats grama, which, if overgrazing continues, can also be grazed out. Silver bluestem, hooded windmillgrass, and hairy grama would then increase. Further heavy grazing causes a decline in all of these plants and an invasion of threeawn, dropseed, red lovegrass, annual grasses, skunkbush sumac, and post oak. Mesquite, juniper, and catclaw can eventually take over and shade out most grasses.

Potential for wildlife habitat is good. This area is inhabited by deer, dove, quail, squirrels, and turkeys. Several of the woody plants, forbs, and grasses provide good cover, browse, mast, and seeds for game birds and animals.

This Apalo soil is well suited to most urban uses. It is moderately well suited to recreation uses. Erosion is a hazard in places.

This soil is in capability subclass IVe and the Sandy Loam range site.

4—Bastrop loamy fine sand, 1 to 5 percent slopes. This deep, well drained, gently sloping soil is on terraces along major streams. Areas are somewhat rounded and elongated, and slopes are convex. They range from 20 to 140 acres.

Typically, the surface layer is neutral, light brown loamy fine sand about 15 inches thick. From a depth of 15 to 45 inches is slightly acid, red sandy clay loam.

Below that to a depth of 65 inches is slightly acid, yellowish red sandy clay loam.

Permeability is moderate, and available water capacity is high. The hazard of soil blowing is moderate, and the hazard of water erosion is severe. Runoff is slow. The soil can be worked throughout a wide range of moisture conditions. The root zone is deep and easily penetrated by plant roots (fig. 7). This soil responds well to fertilization.

Included with this soil in mapping are small areas of Decordova, Apalo, and Minwells soils. Decordova soils are on upper slopes. Minwells soils are on lower slopes.

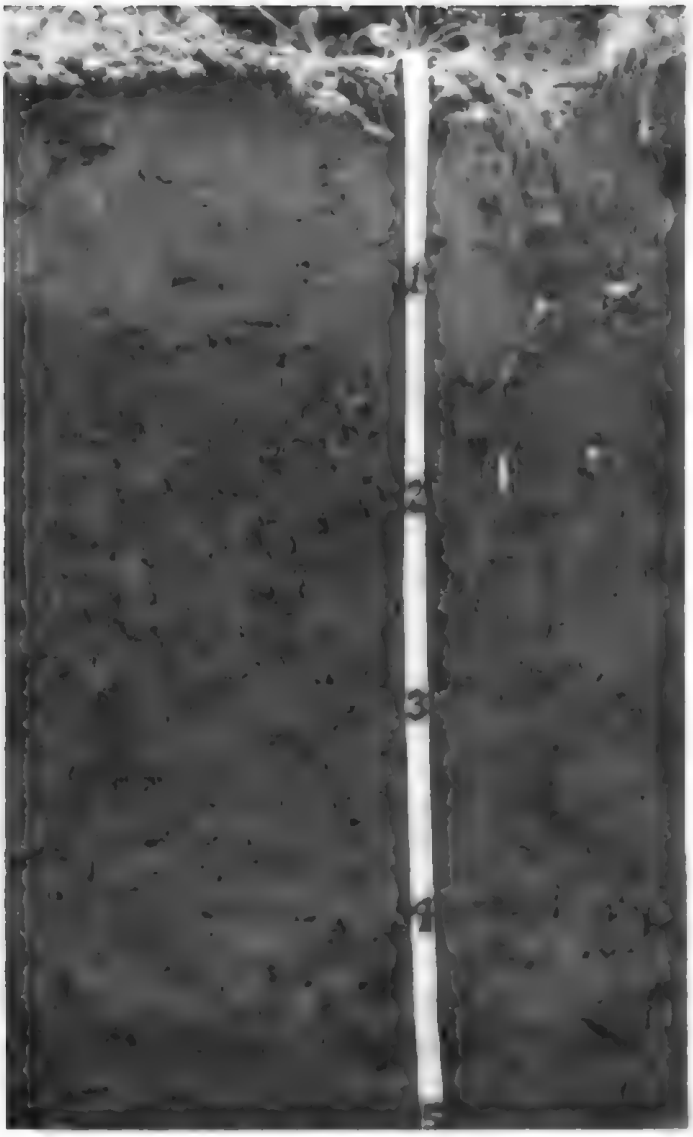


Figure 7.—Profile of Bastrop loamy fine sand, 1 to 5 percent slopes. Root penetration is unrestricted to a depth of 60 inches. Depths are shown in feet.

Near breaks and on lower slopes are small areas of Apalo soils. Also included are small areas of Bastrop fine sandy loam and some eroded spots and patches of Bastrop soils. These included soils are less than 10 acres and make up less than 15 percent of any mapped area.

This Bastrop soil is mostly used as cropland and pastureland. It is well suited to both uses. A few areas are used as rangeland. Peanuts, sorghum, and truck crops are predominant. Fruit and nut trees are well suited. Using cover crops and wind stripcrops and returning crop residue to the soil help to control soil blowing and improve soil productivity. This soil is well suited to pastureland. Bermudagrass and lovegrass are the main grasses. Crops and pasture grasses respond well to fertilizer.

This Bastrop soil is well suited to use as rangeland. The potential plant community is a post oak savannah with an understory of tall and mid grasses. The predominant plants are—

- little bluestem—30 percent
- big bluestem and indiangrass—15 percent
- sand lovegrass—10 percent
- forbs, such as trailing wildbean, partridge pea, dayflower, dalea, catclaw sensitivebrier, dotted gayfeather, senna, croton, and western ragweed—5 percent
- woody plants, such as post oak—15 percent
- greenbrier, bumelia, pricklyash, blackjack oak, western soapberry, plums, grapes, and sumac—5 percent.

Other important plants are—

- sand and tall dropseed—5 percent
- purpletop tridens—5 percent
- silver bluestem and Texas bluegrass—5 percent.

Big bluestem, indiangrass, sand lovegrass, and palatable forbs are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. They are replaced by silver bluestem, tall dropseed, Texas wintergrass, and woody plants. Continued heavy grazing causes a decline of these plants, except for post oak and woody plants which continue to increase along with an invasion of fall witchgrass; hooded windmillgrass; red, tumble, and gummy lovegrass; tumblegrass; threeawn; mesquite; juniper; and catclaw. The plant community can degenerate to a thick stand of trees and brush.

This soil has good potential for wildlife habitat. It is inhabited by deer, turkeys, squirrels, quail, and dove that feed extensively on acorns and other mast. Other small animals and birds feed, nest, and raise their young on this site. If brush is dense, habitat for most wildlife species declines, although deer use the brush for escape and resting cover.

This soil is well suited to most urban uses and moderately well suited to recreation uses. Erosion is a hazard.

This soil is in capability subclass IIIe and the Loamy Sand range site.

5—Bastrop fine sandy loam, 1 to 3 percent slopes. This deep, well drained, gently sloping soil is on upland terraces along major streams. Areas are irregular in shape and range from 20 to 300 acres.

Typically, the surface layer is brown fine sandy loam about 10 inches thick. From a depth of 10 to 13 inches is reddish brown fine sandy loam. Below that to a depth of 80 inches is sandy clay loam that is reddish brown in the upper part and yellowish red in the lower part. This soil typically is slightly acid in the upper part and ranges from neutral to moderately alkaline in the lower part.

Permeability is moderate, and available water capacity is high. Runoff is slow. The hazard of water erosion is severe, and the hazard of soil blowing is moderate. The soil can be worked throughout a wide range of moisture conditions. The root zone is deep and easily penetrated by plant roots.

Included with this soil in mapping are small areas of Apalo, Decordova, Minwells, and Truce soils. Apalo soils are on lower slopes. Decordova soils are on slightly higher positions. Minwells and Truce soils are on upper slopes. The included soils are less than 10 acres and combined make up less than 20 percent of any mapped area.

This Bastrop soil is mainly used as cropland and is well suited to this use. A few areas are used as rangeland. Peanuts, sorghum, and truck crops are predominant. Fruit and nut trees are well suited to this soil. Using cover crops and returning crop residue to the soil help to control erosion and improve soil productivity. This soil is well suited to use as pastureland. Bermudagrass, lovegrass, and kleingrass are the main grasses. Crops and grasses respond well to fertilizer.

This soil is well suited to use as rangeland. The potential plant community is a post oak savannah with an understory of tall and mid grasses. The predominant plants are—

- little bluestem—30 percent
- big bluestem and sand bluestem—10 percent
- indiangrass—10 percent
- sideoats grama—10 percent
- forbs, such as yellow neptunia, scurfpea, western ragweed, Engelmann-daisy, dotted gayfeather, bundleflower, dalea, and prairie-clover—10 percent
- post oak—10 percent.

Other important plants are—

- cane bluestem and silver bluestem—5 percent
- Scribner panicum—5 percent
- Texas wintergrass—5 percent
- Arizona cottontop and sand lovegrass—5 percent
- small amounts of blackjack oak, elm, pricklyash, bumelia, hackberry, sumac, live oak, elbowbush, greenbrier, and plums.

Big bluestem, indiangrass, switchgrass, and sand lovegrass are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. They are replaced by little bluestem and sideoats grama, which, if overgrazing continues, can also be grazed out. Silver bluestem, hooded windmillgrass, and hairy grama would then increase. Further heavy grazing causes a decline in all of these plants and an invasion of threeawn, dropseed, red lovegrass, annual grasses, skunkbush sumac, and post oak. Mesquite, juniper, and catclaw can eventually take over and shade out most grasses.

Potential for wildlife habitat is good. This area is inhabited by deer, dove, quail, squirrels, and turkeys. Several of the woody plants, forbs, and grasses provide good cover, browse, mast, and seeds for game birds and animals.

This Bastrop soil is well suited to most urban and recreation uses.

This soil is in capability subclass IIe and the Sandy Loam range site.

6—Bastrop fine sandy loam, 3 to 5 percent slopes. This deep, well drained, gently sloping soil is on terraces along major streams. Areas are elongated and follow the contour of the streams. Slopes are convex. Areas are irregular in shape and range from 20 to 100 acres.

Typically, the surface layer is slightly acid, reddish brown fine sandy loam about 15 inches thick. From a depth of 15 to 40 inches is slightly acid, yellowish red sandy clay loam. The next layer, to a depth of 50 inches, is neutral, reddish brown sandy clay loam. Below that to a depth of 70 inches is neutral, yellowish red sandy clay loam.

Permeability is moderate, and available water capacity is high. Tilth is fair, and the soil can be worked throughout a wide range of moisture conditions. Runoff is medium. The hazard of water erosion is severe, and the hazard of soil blowing is moderate. The root zone is deep and easily penetrated by plant roots.

Included with this soil in mapping are small, gently sloping and sloping areas of Truce and Minwells soils. Near breaks and on lower slopes are small areas of Apalo soils. Also included are small areas of Bastrop fine sandy loam, 1 to 3 percent slopes, and some small eroded areas. These included soils are less than 5 acres and make up less than 15 percent of any mapped area.

This Bastrop soil is mainly used as rangeland and is well suited to native grass forage. The potential plant community is a post oak savannah with an understory of tall and mid grasses. The predominant plants are—

- little bluestem—30 percent
- big bluestem and sand bluestem—10 percent
- indiangrass—10 percent
- sideoats grama—10 percent
- forbs, such as yellow neptunia, scurfpea, western ragweed, Engelmann-daisy, dotted gayfeather, bundleflower, dalea, and prairie-clover—10 percent
- post oak—10 percent.

Other important plants are—

- cane bluestem and silver bluestem—5 percent
- Scribner panicum—5 percent

- Texas wintergrass—5 percent
- Arizona cottontop and sand lovegrass—5 percent
- small amounts of blackjack oak, elm, pricklyash, bumelia, hackberry, sumac, live oak, elbowbush, greenbrier, and plums.

Big bluestem, indiangrass, switchgrass, and sand lovegrass are preferred by livestock; therefore, they are grazed out if grazing is not controlled. They are replaced by little bluestem and sideoats grama, which, if overgrazing continues, can also be grazed out. Silver bluestem, hooded windmillgrass, and hairy grama would then increase. Further heavy grazing causes an invasion of threeawn, dropseed, red lovegrass, annual grasses, skunkbush sumac, and post oak. Mesquite, juniper, and catclaw can eventually take over and shade out most grasses.

Potential for wildlife habitat is good. This area is inhabited by deer, dove, quail, squirrels, and turkeys. Several of the woody plants, forbs, and grasses provide good cover, browse, mast, and seeds for game birds and animals.

This soil is mainly used as rangeland. A few areas are used as cropland and pastureland.

This soil is moderately well suited to use as cropland. Peanuts, sorghum, and small grain are the main crops. Fruit and nut trees are well suited to this soil. Using terraces, contour farming, and returning crop residue to the soil help to control erosion, conserve moisture, and maintain productivity.

This soil is well suited to use as pastureland. Bermudagrass, kleingrass, and lovegrass are the main grasses.

This Bastrop soil is suited to most urban and recreation uses.

This soil is in capability subclass IIIe and the Sandy Loam range site.

7—Bastrop fine sandy loam, 1 to 5 percent slopes, eroded. This deep, well drained, gently sloping soil is on terraces along major streams. Most areas of this soil were used as cropland. Some areas, once cultivated fields, have been eroded and are now used as pastureland or rangeland. A few areas are overgrazed rangeland. Areas of this map unit are dissected by rills and gullies and, by having a thin surface layer, show evidence of sheet erosion. Gullies commonly are 5 to 30 feet wide, 100 to 300 feet apart, and from a few inches to 3 feet deep. Most of them are crossable with farm machinery. Areas follow the slope contour above streams. Areas are irregular in shape and range from 20 to 100 acres.

Typically, the surface layer is neutral, light brown fine sandy loam about 4 inches thick. From a depth of 4 to 30 inches is neutral, yellowish red sandy clay loam. The next layer, to a depth of 50 inches, is neutral, yellowish red sandy clay loam. Below that to a depth of 65 inches or more is mildly alkaline, red sandy clay loam.

Permeability is moderate, and available water capacity is high. Runoff is rapid. The hazard of soil blowing is moderate. The hazard of water erosion is severe. The root zone is deep and easily penetrated by plant roots. This soil responds well to fertilization.

Included with this soil in mapping are small, gently sloping areas of Apalo, Minwells, and Truce soils. Also included on some lower slopes are small areas of Yahola soils, nearly level Bastrop soils, sloping Bastrop soils, and non-eroded soils. The included soils are less than 5 acres and make up less than 10 percent of any mapped area.

This Bastrop soil is mainly used as rangeland and is well suited to this use. The potential plant community is a post oak savannah with an understory of tall and mid grasses. The predominant plants are—

- little bluestem—30 percent
- big bluestem and sand bluestem—10 percent
- indiangrass—10 percent
- sideoats grama—10 percent
- forbs, such as yellow neptunia, scurfpea, western ragweed, Engelmann-daisy, dotted gayfeather, bundleflower, dalea, and prairie-clover—10 percent
- post oak—10 percent.

Other important plants are—

- cane bluestem and silver bluestem—5 percent
- Scribner panicum—5 percent
- Texas wintergrass—5 percent
- Arizona cottontop and sand lovegrass—5 percent
- small amounts of blackjack oak, elm, pricklyash, bumelia, hackberry, sumac, live oak, elbowbush, greenbrier, and plums.

Big bluestem, indiangrass, switchgrass, and sand lovegrass are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. They are replaced by little bluestem and sideoats grama, which, if overgrazing continues, can also be grazed out. Silver bluestem, hooded windmillgrass, and hairy grama would then increase. Further heavy grazing causes an invasion of threeawn, dropseed, red lovegrass, annual grasses, skunkbush sumac, and post oak. Mesquite, juniper, and catclaw can eventually take over and shade out most grasses.

Potential for wildlife habitat is good. This area is inhabited by deer, dove, quail, squirrels, and turkeys. Several of the woody plants, forbs, and grasses provide good cover, browse, mast, and seeds for game birds and animals.

This soil is moderately well suited to use as cropland. Sorghum and small grain are major crops. Fruit and nut trees are well suited to this soil. Using terraces, contour farming, and returning crop residue to the soil help to control erosion, conserve moisture, and maintain productivity. This soil is well suited to use as pastureland. Bermudagrass, kleingrass, and lovegrass are the main grasses.

This Bastrop soil is well suited to most urban uses and moderately well suited to recreation uses. Slope is a limitation in places.

This soil is in capability subclass IIIe and the Sandy Loam range site.

8—Blanket clay loam, 0 to 1 percent slopes. This deep, well drained, nearly level soil is in broad valleys. Areas are irregular in shape, and small drainageways run through them. These areas range from 15 to 100 acres.

Typically, the surface layer is dark grayish brown clay loam about 18 inches thick. Below that to a depth of 60 inches is clay loam that is very dark grayish brown in the upper part, brown in the middle part, and light brownish gray in the lower part. This soil typically is mildly alkaline in the upper part and moderately alkaline in the lower part.

This soil is productive. Permeability is moderately slow, and available water capacity is high. This soil receives additional moisture as runoff from adjacent soils that are higher on the landscape. Runoff is slow. The hazards of water erosion and soil blowing are slight. This soil can be worked well in a narrow range of moisture conditions. The root zone is deep and easily penetrated by roots.

Included with this soil in mapping are small areas of Bosque, Santo, Thurber, and Velow soils of as much as 5 acres. Bosque and Santo soils are on flood plains. Thurber soils are on broad flats. Velow soils are on convex knolls. These included soils make up less than 15 percent of any mapped area.

A large area of this Blanket soil is used as pastureland and is well suited to this use. Some areas are used as cropland. Bermudagrass and kleingrass respond well to fertilizers and can produce high yields if properly managed.

Crops are well suited to this soil. Sorghum, truck crops, and small grain are predominant. Terraces and contour farming help to control erosion and conserve moisture. Leaving crop residue on the surface also conserves moisture while maintaining soil tilth and productivity.

This soil is suited to use as rangeland. The potential plant community is a prairie of tall and mid grasses. The predominant plants are—

- big bluestem and switchgrass—15 percent
- little bluestem—25 percent
- indiangrass—10 percent
- sideoats grama—10 percent.

Other important plants are—

- cane bluestem and silver bluestem—5 percent
- vine-mesquite—5 percent
- Texas wintergrass—5 percent
- woody plants, such as Engelmann-daisy, bundleflower, prairie-clover, Maximilian sunflower, sensitivebrier, and halfshrub sundrop, make up the rest.

Big bluestem, switchgrass, indiangrass, and many perennial forbs are preferred by livestock; therefore they are grazed out of the community if grazing is not controlled. These plants are replaced by little bluestem, sideoats grama, cane and silver bluestem, vine-mesquite, and Texas wintergrass. Continued overgrazing causes an invasion of threeawn, Texas grama, annual grasses and weeds, lotebush, pricklypear, tasajillo, juniper, and mesquite.

Potential for wildlife habitat is fair. This area is inhabited by deer, dove, and quail. Several of the forbs and grasses provide seed for game birds and animals. A good selection of forbs for deer forage is provided but little cover and protection for escape and resting.

This Blanket soil is moderately well suited to most urban and recreation uses. Shrink-swell potential is a limitation for these uses. Low strength is a limitation for roads and streets, the moderately slow permeability is a limitation for septic tank filter fields, and the clayey surface layer is a limitation for playgrounds and picnic areas.

This soil is in capability class I and the Clay Loam range site.

9—Bonti fine sandy loam, 1 to 3 percent slopes. This moderately deep, well drained, gently sloping soil is on uplands. Areas are irregular in shape and range from 15 to 200 acres.

Typically, the surface layer is slightly acid, light brown fine sandy loam about 9 inches thick. From a depth of 9 to 25 inches is medium acid, red clay. Extending from 25 to 36 inches is medium acid, yellowish red clay. Below that is reddish, strongly cemented sandstone bedrock.

The organic matter content is low. Permeability is moderately slow, and available water capacity is low. A hard crust forms on the surface when the soil is dry. Tilth is poor, and the soil can be worked well in a narrow range of moisture content. Runoff is medium. The hazard of water erosion is severe, and the hazard of soil blowing is moderate. The root zone is moderately deep, and roots are restricted by dense, clayey lower layers. This soil responds to fertilization.

Included with this soil in mapping are small areas of Truce and Vashti soils. The included soils are as much as 20 acres. They make up less than 15 percent of any mapped area.

This Bonti soil is mainly used as rangeland and is moderately well suited to this use (fig. 8). The potential plant community is a mid grass, post oak savannah. The predominant plants are—

- sideoats grama—30 percent
- vine-mesquite—15 percent
- Arizona cottontop—10 percent
- little bluestem, blue grama, silver bluestem, buffalograss, and Texas wintergrass—5 percent each
- post oak—10 percent
- hooded windmillgrass and perennial threeawn—5 percent
- forbs, such as western ragweed, heath aster, sagewort, sensitivebrier, and primrose
- a small amount of cedar elm, pricklyash, skunkbush sumac, lotebush, and agarito.

Figure 8.—Little bluestem and post oak and blackjack oak trees on Bonti fine sandy loam, 1 to 3 percent slopes.

Sideoats grama, Arizona cottontop, and vine-mesquite are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. These plants are replaced by buffalograss, hooded windmillgrass, Texas wintergrass, and post oak. Continued overgrazing causes a decline in all of these plants except buffalograss and post oak, which increase along with an invasion of hairy tridens, Texas grama, mesquite, juniper, pricklypear, and tasajillo.

Potential for wildlife habitat is good. Quail and dove inhabit this area. Deer and turkeys feed in this area and use cover on adjacent soils.

This Bonti soil is moderately well suited to use as cropland. Forage sorghum and small grain are major crops. Terraces and contour farming help to control erosion. Leaving crop residue on the soil helps to conserve moisture, reduce crusting, and maintain productivity. Tillage should be timely and limited. Pasture production is high if proper management of pastureland is used. Improved grasses, such as kleingrass, Coastal bermudagrass, and lovegrass are adapted to this soil.

This soil is moderately well suited to most urban uses and recreation uses. The depth to rock and the slow water intake rate are limitations for septic tank filter fields. Depth to rock is also a limitation for dwellings and is difficult to overcome.

This soil is in capability subclass IIe and the Tight Sandy Loam range site.

10—Bonti fine sandy loam, 3 to 5 percent slopes. This moderately deep, well drained, gently sloping soil is on ridgetops. Areas are irregular to elongated in shape and are on crests and slopes of ridges. Areas range from 15 to 30 acres.

Typically, the surface layer is slightly acid, brown fine sandy loam about 11 inches thick. From a depth of 11 to

32 inches is medium acid, yellowish red clay. Below that is sandstone bedrock.

Permeability is moderately slow, and available water capacity is medium. A hard crust forms on the surface when the soil is dry. Tilth is poor, and the soil can be worked well in a narrow range of moisture conditions. Runoff is rapid, and the hazard of water erosion is severe. The hazard of soil blowing is moderate. The root zone is moderately deep, and roots are restricted by the dense, clayey lower layers. This soil responds to fertilization. The organic matter content is low.

Included with this soil in mapping are small areas of gently sloping and sloping Truce and Vashti soils. Vashti soils are along ridges, and Truce soils are on foot slopes and upper slopes that lead down to more sloping areas. Also included are areas of stony Bonti soils and Hassee soils in some slight depressions. These included soils are less than 10 acres and together make up less than 20 percent of any mapped area.

This Bonti soil is mainly used as rangeland. It is moderately well suited to this use. The potential plant community is a mid grass, post oak savannah. The predominant plants are—

- sideoats grama—30 percent
- vine-mesquite—15 percent
- Arizona cottontop—10 percent
- little bluestem, blue grama, silver bluestem, buffalograss, and Texas wintergrass—5 percent each
- post oak—10 percent
- hooded windmillgrass and perennial threeawn—5 percent
- forbs, such as western ragweed, heath aster, sagewort, sensitivebrier, and primroses
- a small amount of cedar elm, pricklyash, skunkbush sumac, lotebush, and agarito.

Sideoats grama, Arizona cottontop, and vine-mesquite are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. These plants are replaced by buffalograss, hooded windmillgrass, Texas wintergrass, and post oak. Continued overgrazing causes a decline in all of these plants except buffalograss and post oak, which increase along with an invasion of hairy tridens, Texas grama, mesquite, juniper, pricklypear, and tasajillo.

Potential for wildlife habitat is good. Quail and dove inhabit this area. Deer and turkeys feed in this area and use cover on adjacent soils.

This soil is poorly suited to use as cropland. Forage sorghum and small grain are major crops. Terraces and contour farming help to control erosion. Leaving crop residue on the soil helps to conserve moisture, resist crusting, and maintain productivity. Tillage should be timely and limited. This soil is moderately well suited to use as pastureland. Improved grasses, such as kleingrass and King Ranch bluestem, are adapted to this soil.

This Bonti soil is moderately well suited to most urban uses. The depth to rock and the slow water intake rate are limitations for septic tank absorption fields. Depth to rock is also a limitation for dwellings and is difficult to overcome.

This soil is moderately well suited to recreational uses. Slope is a limitation in places.

This soil is in capability subclass IIIe and the Tight Sandy Loam range site.

11—Bonti-Exray complex, very stony, 1 to 8 percent slopes. These moderately deep and shallow, well drained, gently sloping and sloping soils are on crests of ridges and hills. Sandstone fragments and stones ranging from 10 to 36 inches in diameter cover 3 to 15 percent of the surface. Most areas are elongated and follow the upper contour of hills and ridges. The areas range from 20 to several hundred acres.

About 52 percent of this complex is Bonti soil, 30 percent is Exray soil, and 18 percent is other soils. The areas of Bonti and Exray soils are so intricately mixed, or so small in size, that it is not practical to map them separately.

Typically, the Bonti soil has a very stony, dark grayish brown surface layer about 2 inches thick. Sandstone fragments, 10 to 36 inches in diameter, cover about 10 percent of the surface. From a depth of 2 to 5 inches is light yellowish brown fine sandy loam. From a depth of 5 to 24 inches is red clay. Below that is strongly cemented sandstone bedrock. This soil typically is neutral in the upper part and grades to strongly acid in the lower part.

Permeabilty of this Bonti soil is moderately slow, and available water capacity is low. The surface layer is hard and massive when dry. Runoff is rapid. The hazards of water erosion and soil blowing are slight because of the many stones on the surface. The root zone is moderately deep.

Typically, the Exray soil has a slightly acid, very stony fine sandy loam surface layer about 2 inches thick. Sandstone fragments, 10 to 36 inches in diameter, cover about 15 percent of the surface. From a depth of 3 to 5 inches is slightly acid, yellowish brown fine sandy loam. From a depth of 5 to 16 inches is medium acid, red clay. Below that is strongly cemented sandstone bedrock.

Permeability of the Exray soil is moderately slow, and available water capacity is low. The surface layer is hard and massive when dry. Surface runoff is rapid. The hazards of water erosion and soil blowing are slight. The root zone is shallow.

Included in most areas of this complex are spots and patches of Vashti soils ranging from 2 to 5 acres and as much as 2 acres of rock outcrop. In places are areas of Truce, Shavash, and non-stony Bonti soils that range from 3 to 10 acres. These inclusions average about 18 percent of any mapped area.

The soils in this complex are used almost exclusively as rangeland and are moderately well suited to this use. The potential plant community on the Bonti soil is a mid grass, post oak savannah (fig. 9). The predominant plants are—

- sideoats grama—30 percent
- vine-mesquite—15 percent
- Arizona cottontop—10 percent
- little bluestem, blue grama, silver bluestem, buffalograss, and Texas wintergrass—5 percent each
- post oak—10 percent
- hooded windmillgrass and perennial threeawn—5 percent
- forbs, such as western ragweed, heath aster, sagewort, sensitivebrier, and primroses
- a small amount of cedar elm, pricklyash, skunkbush sumac, lotebush, and agarito.

Sideoats grama, Arizona cottontop, and vine-mesquite are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. These plants are replaced by buffalograss, hooded windmillgrass, Texas wintergrass, and post oak. Continued overgrazing causes a decline in all of these plants, except buffalograss and post oak which increase along with an invasion of hairy tridens, Texas grama, mesquite, juniper, pricklypear, and tasajillo.

The potential plant community on the Exray soil is an open post oak savannah with an understory of tall and mid grasses. The predominant plants are—

- little bluestem—30 percent
- big bluestem and sand bluestem—10 percent
- indiangrass—10 percent
- sideoats grama—10 percent
- forbs, such as yellow neptunia, scurfpea, western ragweed, Engelmann-daisy, dotted gayfeather, bundleflower, dalea, and prairie-clover—10 percent
- post oak—10 percent.

Other important plants are—

- cane bluestem and silver bluestem—5 percent
- Scribner panicum—5 percent
- Texas wintergrass—5 percent
- Arizona cottontop and sand lovegrass—5 percent
- small amounts of blackjack oak, elm, pricklyash, bumelia, hackberry, sumac, live oak, elbowbush, greenbrier, and plums.

Big bluestem, indiangrass, switchgrass, and sand lovegrass are preferred by livestock; therefore, they are

Figure 9.—This area of Bonti-Exray complex, very stony, 1 to 8 percent slopes, is an example of proper grazing.

grazed out first if grazing is not controlled. They are replaced by little bluestem and sideoats grama. Continued overgrazing causes these plants to be grazed out also. Silver bluestem, hooded windmillgrass, and hairy grama would then increase. Further heavy grazing causes an invasion of threeawn, dropseed, red lovegrass, annual grasses, skunkbush sumac, and post oak. Mesquite, juniper, and catclaw can eventually take over and shade out most grasses.

Potential for wildlife habitat is good. Quail and dove inhabit this area. Deer and turkeys feed in this area and use cover on adjacent soils.

The soils in this complex are poorly suited to use as cropland and pastureland and for urban uses. Stones on the surface is a limitation that is difficult to overcome. In places, however, esthetic values more than offset the limitations, and dwellings are being built in beautiful settings.

These soils are poorly suited to most recreation uses because of stones and slope.

This complex is in capability subclass VIs. The Bonti soil is in the Tight Sandy Loam range site, and the Exray soil is in the Sandy Loam range site.

12—Bosque clay loam, occasionally flooded. This deep, well drained, nearly level soil is in bands along the flood plains of major streams. Flooding usually occurs once for a brief period every 5 to 10 years. Areas are long and narrow in shape and range from 20 to 300 acres.

Typically, the surface layer is clay loam about 34 inches thick. It is brown in the upper part and dark grayish brown in the lower part. The underlying layer to a depth of 60 inches is clay loam that is brown in the upper part and yellowish brown in the lower part. This soil is calcareous and moderately alkaline throughout.

This soil is productive. Permeability is moderate, and available water capacity is high. The soil has good tilth and can be worked throughout a wide range of moisture conditions. Runoff is slow, and the hazard of water erosion is moderate. The hazard of soil blowing is slight. The root zone is deep and easily penetrated by plant roots.

Included with this soil in mapping are small spots of Frio and Santo soils. Frio soils are on the broader flood plains. Santo soils are along the edges of stream channels. The included soils are less than 5 acres and together make up less than 20 percent of any mapped area.

The Bosque soil is mainly used as cropland and is well suited to this use. Some areas are used as rangeland and pastureland. Grain sorghum, small grain, forage sorghum, and alfalfa are major crops. Pecan orchards are also well suited to this soil. Leaving crop residue on the soil helps to conserve moisture, maintain tilth, and maintain productivity. This soil is well suited to use as pastureland. Improved grasses, such as Coastal bermudagrass and kleingrass, are predominant.

This soil is well suited to use as rangeland. The potential plant community is a tall grass savannah with a 10 to 15 percent canopy of woody plants. The predominant plants are—

- indiangrass—20 percent
- big bluestem—10 percent
- switchgrass—15 percent
- little bluestem—15 percent
- the rest is forbs, such as Maximilian sunflower, Engelmann-daisy, trailing wildbean, Baldwin ironweed, catclaw sensitivebrier, trailing ratany, heath aster, gaura, and dalea, and woody plants, such as American elm, pecan, live oak, hackberry, cottonwood, bumelia, and elbowbush.

Indiangrass, big bluestem, and switchgrass are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. They are replaced by sideoats grama, dropseed, Texas wintergrass, and woody plants. Continued overgrazing causes a decrease of these plants, except for woody plants which continue to increase along with an invasion of western ragweed, nightshade, common bermudagrass, and buffalograss.

Potential for wildlife habitat is good. This area is inhabited by deer, turkeys, dove, and quail. Turkeys commonly use the large trees for roosting. Many of the choice forage plants for deer and turkeys in the area are produced on this soil. This soil also produces excellent resting, nesting, and escape cover.

The Bosque soil is poorly suited to most urban uses. Flooding is the main limitation that can be overcome only by major flood control measures. The soil is well suited to recreation uses.

This soil is in capabilty subclass IIw and the Loamy Bottomland range site.

13—Chaney loamy fine sand, 1 to 5 percent slopes. This deep, moderately well drained, gently sloping soil is on uplands. Areas are irregular in shape and range from 20 to over 100 acres.

Typically, the surface layer is slightly acid, pale brown loamy fine sand about 6 inches thick. From a depth of 6 to 16 inches is slightly acid, very pale brown loamy fine sand. At a depth of 16 to 30 inches is slightly acid, red sandy clay with light brownish gray and yellowish brown mottles. From a depth of 30 to 45 inches is slightly acid, brownish yellow clay with grayish brown mottles. Below that to a depth of 60 inches is moderately alkaline, reddish yellow clay with grayish brown mottles (fig. 10).

Permeability is slow, and available water capacity is medium. The hazard of soil blowing is severe. The hazard of water erosion is slight. This soil is moderately well drained. A temporary water table is perched above the clayey lower layers during periods of heavy rainfall. The root zone is deep, but the clayey lower layers restrict root penetration. This soil responds well to fertilizer.

Included with this soil in mapping are small eroded areas of Chaney soils. On slightly higher ridges are small

Figure 10.—Profile of Chaney loamy fine sand, 1 to 5 percent slopes. Mottling is evident in lower layers. Depths are shown in feet.

areas of Bonti, Demona, and Truce soils. Hassee and Thurber soils are in slight depressions. The included soils are as much as 10 acres and together make up less than 20 percent of any mapped area.

This Chaney soil is used mainly as cropland. Some areas are used as rangeland and pastureland. The soil is well suited to peanuts, sorghums, fruit orchards, pecan orchards, and truck crops. Leaving crop residue on the soil helps to conserve moisture, slow runoff, reduce soil blowing, and maintain productivity. Wind stripcropping and using cover crops help to control soil blowing. Improved pasture grasses, such as Coastal bermudagrass and lovegrass are well suited to this soil.

This soil is well suited to use as rangeland. The potential plant community is a post oak savannah with an understory of tall and mid grasses. The predominant plants are—

- little bluestem—35 percent
- big bluestem and indiangrass—15 percent
- sand lovegrass—10 percent
- forbs, such as trailing wildbean, partridge pea, dayflower, dalea, catclaw sensitivebrier, dotted gayfeather, senna, croton, and western ragweed—5 percent
- woody plants, such as post oak—15 percent
- greenbrier, bumelia, pricklyash, blackjack oak, western soapberry, plums, grapes, and sumac—5 percent.

Other important plants are—

- sand dropseed and tall dropseed—5 percent
- purpletop tridens—5 percent
- silver bluestem and Texas bluegrass—5 percent.

Big bluestem, indiangrass, sand lovegrass, and palatable forbs are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. They are replaced by silver bluestem, tall dropseed, Texas wintergrass, and woody plants. Continued overgrazing causes a decline of these plants, except for post oak and the woody plants which continue to increase along with an invasion of fall witchgrass, hooded windmillgrass, red and tumble and gummy lovegrass, tumblegrass, threeawn, mesquite, juniper, and catclaw. The plant community finally degenerates to a thick stand of trees and brush.

This soil has good potential for wildlife habitat. Deer, turkeys, squirrels, quail, and dove inhabit the area. They feed extensively on acorns and other mast. Other small animals and birds feed, nest, and raise their young on this site. If brush is dense, habitat for most wildlife species declines, although deer use the brush for escape and resting cover.

This Chaney soil is moderately well suited to most urban uses. Shrink-swell potential and low strength are limitations for roads and streets, but they can be overcome by using proper design and careful installation procedures. The clayey lower layers take in water slowly. This is a limitation for septic tank filter fields but can be overcome by increasing the size of the field.

This soil is moderately well suited to recreation uses. The main limitation is the loose sandy surface layer.

This soil is in capability subclass IIIe and the Loamy Sand range site.

14—Decordova loamy fine sand, 0 to 5 percent slopes. This deep, well drained, nearly level and gently sloping soil is on terraces on the inside of the bends in the Brazos River. Areas are irregular in shape and range from 30 to 200 acres.

Typically, the surface layer is light brown loamy fine sand about 6 inches thick. From a depth of 6 to 80 inches is fine sandy loam that is reddish brown in the upper part and yellowish red in the lower part. Reaction is neutral or slightly acid throughout.

Permeability is moderately rapid, and available water capacity is medium. The hazard of soil blowing is severe. The hazard of water erosion is slight. The root zone is deep and easily penetrated by plant roots. This soil responds to fertilization.

Included with this soil in mapping are small spots of Bastrop and Eufaula soils on low knolls. These included soils are as much as 15 acres and make up less than 20 percent of any mapped area.

This soil is mainly used as cropland and is well suited to this use. Some areas are used as rangeland and pastureland. Peanuts, sorghum, and truck crops are predominant. Fruit and nut trees are well suited to this soil. Using cover crops, wind stripcropping, and leaving crop residue on the soil help to control soil blowing and improve productivity. Pasture yields are high if proper management is used. Bermudagrass and lovegrass are the main grasses.

This Decordova soil is well suited to use as rangeland. The potential plant community is a post oak savannah with an understory of tall and mid grasses. The predominant plants are—

- little bluestem—35 percent
- big bluestem and indiangrass—15 percent
- sand lovegrass—10 percent
- forbs, such as trailing wildbean, partridge pea, dayflower, dalea, catclaw sensitivebrier, dotted gayfeather, senna, croton, and western ragweed—5 percent
- woody plants, such as post oak—15 percent
- greenbrier, bumelia, pricklyash, blackjack oak, western soapberry, plums, grapes, and sumac—5 percent.

Other important plants are—

- sand dropseed and tall dropseed—5 percent
- purpletop tridens—5 percent
- silver bluestem and Texas bluegrass—5 percent.

Big bluestem, indiangrass, sand lovegrass, and palatable forbs are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. They are replaced by silver bluestem, tall dropseed, Texas wintergrass, and woody plants. Continued overgrazing causes a decline of these plants, except for post oak and woody plants, which continue to increase along with an invasion of fall witchgrass; hooded windmillgrass; red, tumble, and gummy lovegrass; tumblegrass; threeawn; mesquite; juniper; and catclaw. The plant community can finally degenerate to a thick stand of trees and brush.

Potential for wildlife habitat is good. This area is inhabited by deer, turkeys, squirrels, quail, and dove that feed extensively on acorns and other mast. Other small animals and birds feed, nest, and raise their young on this site. If brush is dense, habitat for most wildlife species declines, although deer use the brush for escape and resting cover.

This soil is well suited to most urban uses. It is moderately well suited to recreation uses. The main limitation is the loose, sandy surface layer.

This soil is in capability subclass IIIe and the Loamy Sand range site.

15—Demona loamy sand, 0 to 5 percent slopes. This deep, moderately well drained, nearly level to gently sloping soil is on broad uplands. Areas are irregular in shape and range from 20 to 200 acres.

Typically, the surface layer is about 26 inches thick. The upper 6 inches is neutral, brown loamy sand, and the lower 20 inches is slightly acid, very pale brown loamy sand. From a depth of 26 to about 54 inches is sandy clay that is red in the upper part and brownish yellow in the lower part. This layer has reddish and grayish mottles throughout and is medium acid to strongly acid. Below that to a depth of 62 inches is medium acid, light gray clay.

Permeability is moderately slow, and available water capacity is medium. This soil responds to fertilization. The hazard of soil blowing is severe (fig. 11). The hazard of water erosion is slight. A temporary water table is perched above the clayey lower layers during periods of heavy rainfall. The root zone is deep, but the clayey lower layers restrict some root penetration.

Included with this soil in mapping are small areas of Chaney soils on low knolls that are as much as 10 acres and make up less than 15 percent of any mapped area.

This Demona soil is mainly used as cropland. Some areas are used as rangeland and pastureland. The soil is well suited to peanuts, sorghum, fruit orchards, pecan orchards, and truck crops. Leaving crop residue on the soil helps to conserve moisture, reduce soil blowing, and maintain productivity. Wind stripcropping and using cover crops help to control soil blowing. Pasture production is high if proper management is used. Improved grasses, such as Coastal bermudagrass and lovegrass, are predominant.

Rangeland is well suited to this soil. The potential plant community on the Demona soil is a post oak and blackjack oak savannah. The predominant plants are—

- little bluestem—25 percent
- sand bluestem and big bluestem—10 percent
- sand lovegrass—10 percent
- indiangrass—10 percent

Figure 11.—Area of Demona loamy sand, 0 to 5 percent slopes. Soil blowing is a hazard on this soil.

- forbs, such as dayflower, trailing wildbean, lespedeza, dalea, eveningprimrose, and western ragweed,—5 percent
- post oak and blackjack oak—20 percent
- the rest is purpletop tridens, tall dropseed, Scribner panicum, greenbrier, bumelia, pricklyash, and sumac.

Big bluestem, sand bluestem, and indiangrass are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. These plants are replaced by silver bluestem and ragweed. Continued overgrazing causes a decline in these plants, except for the woody plants which increase along with annual lovegrasses, sand dropseed, hooded windmillgrass, annual forbs, shin oak, and juniper. The trees and brush may increase to such a density that most of the grasses are shaded out.

Potential for wildlife habitat is good. This area is inhabited by deer, turkeys, quail, and dove. If brush is dense, habitat for most wildlife species declines because of scarce forage. Deer use the areas of thick brush for escape and resting cover.

This Demona soil is moderately well suited to most urban and recreation uses. Shrink-swell potential and low strength, which affects roads and streets, are limitations. They can be overcome by using proper design and installation procedures. The clayey lower layers of this soil take in water slowly, and this is a limitation for septic tank filter fields. The loose, sandy surface layer is a limitation for some recreation uses, such as playgrounds and camp sites.

This soil is in capability subclass IIIe and the Sandy range site.

16—Eufaula loamy fine sand, 5 to 8 percent slopes. This deep, somewhat excessively drained, sloping soil is on terraces along the Brazos River. Areas are irregular in shape and range from 30 to 200 acres.

Typically, the surface layer is slightly acid loamy fine sand about 45 inches thick. The upper 8 inches is very pale brown, and the lower 37 inches is pink. From a depth of 45 to 80 inches is slightly acid, pink loamy fine sand that contains common, thin bands of reddish yellow fine sandy loam.

Permeability is rapid, and available water capacity is low. The hazard of soil blowing is severe. The hazard of water erosion is slight. The root zone is deep and is easily penetrated by plant roots. This soil responds to fertilization and irrigation, both of which should be applied frequently and in small amounts.

Included with this soil in mapping are small areas of Apalo, Bastrop, and Decordova soils which are generally on lower slopes. They are less than 10 acres and together make up less than 15 percent of any mapped area.

This Eufaula soil is mainly used as rangeland and is moderately well suited to this use. The potential plant community is a post oak and blackjack oak savannah. The predominant plants are—

- indiangrass, big bluestem, and sand bluestem—15 percent
- sand lovegrass—10 percent
- forbs, such as trailing wildbean, lespedeza, eveningprimrose, bundleflowers, and bullnettle—10 percent
- woody plants, such as post oak—15 percent
- blackjack oak—10 percent
- greenbrier—10 percent
- pricklyash—5 percent.

Other important plants are—

- sand dropseed—5 percent
- little bluestem—5 percent
- purpletop tridens—5 percent
- sand paspalum—5 percent
- Scribner panicum—5 percent.

Indiangrass, big bluestem, sand bluestem, and sand lovegrass are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. These plants are replaced by sand dropseed, fringeleaf paspalum, Scribner panicum, purpletop tridens, oak, and other brush species. Continued overgrazing causes a decline of these plants, except for oak and other brush species. Thus, woody plants can eventually dominate this soil.

Potential for wildlife habitat is fair. Deer and turkeys are the main species. Where the brush is thick, escape cover for deer is provided.

Crop yields are generally low on this soil. The slope and inability to store moisture make this soil best suited to range or pasture. It is moderately well suited to pastureland. Deep rooted grasses, such as lovegrass or Coastal bermudagrass, are adapted species.

This soil is moderately well suited to most urban uses. Slope is a major limitation for this use, along with the hazard of soil blowing.

The Eufaula soil is moderately well suited to most recreation uses. The main limitations are the sandy texture and slope.

This soil is in capability subclass VIe and the Deep Sand range site.

17—Frio clay loam, occasionally flooded. This deep, well drained, nearly level soil is on flood plains along major streams. Flooding for brief periods occurs about once every 5 to 10 years. Areas are elongated and follow the contour of streams. Areas range from 15 to 500 acres.

Typically, the surface layer is moderately alkaline, dark grayish brown clay loam about 8 inches thick. From a depth of 8 to 20 inches is moderately alkaline, dark grayish brown silty clay loam. At a depth of 20 to 40 inches is moderately alkaline, brown silty clay loam. Below that to a depth of 60 inches is moderately alkaline, pale brown clay loam.

This soil is productive. Permeability is moderately slow, and available water capacity is high. The hazard of soil blowing is slight. The hazard of water erosion is severe. The root zone is deep and is easily penetrated by plant roots. Tilth is good. The soil can be worked throughout a wide range of moisture conditions; however it is very sticky and plastic when wet.

Included with this soil in mapping are small areas of Bosque and Santo soils, mostly along banks of streams. Also included are a few areas of Frio soils that are frequently flooded and some sloping soils on streambanks. The included soils make up less than 25 percent of any mapped area.

This Frio soil is mainly used as cropland. It is suited to this use, but occasional flooding is a hazard. Crop yields are high. Sorghum, corn, cotton, alfalfa, and small grain are the major crops. Leaving crop residue on the soil helps to conserve moisture and maintain tilth and productivity. This soil is well suited to use as pastureland. Grasses, such as bermudagrass, kleingrass, and lovegrass, are well suited to this soil.

This soil is suited to use as rangeland. The potential plant community is a tall grass savannah with a 10 to 15 percent canopy of woody plants. The predominant plants are—

- indiangrass—20 percent
- big bluestem—10 percent
- switchgrass—15 percent
- little bluestem—15 percent
- the rest is forbs, such as Maximilian sunflower, Engelmann-daisy, trailing wildbean, Baldwin ironweed, catclaw sensitivebrier, trailing ratany, heath aster, gaura, and dalea; and woody plants, such as American elm, pecan, live oak, hackberry, cottonwood, bumelia, and elbowbush.

Indiangrass, big bluestem, and switchgrass are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. They are replaced by sideoats grama, dropseed, Texas wintergrass, and woody plants. Continued overgrazing causes a decrease of these plants, except for woody plants that continue to increase along with an invasion of western ragweed, nightshade, common bermudagrass, and buffalograss.

Potential for wildlife habitat is good. Deer, turkeys, dove, and quail inhabit the area. Turkeys commonly use the large trees for roosting. Many of the choice forage plants for deer and turkeys are produced on this soil. Excellent resting, nesting, and escape cover is also provided.

This soil is poorly suited to urban uses. Flooding is a limitation that is difficult to overcome without major flood control measures.

The Frio soil is moderately well suited to most recreation uses. Flooding is the main hazard, and the clayey texture is the main limitation.

This soil is in capability subclass IIw and the Loamy Bottomland range site.

18—Frio clay loam, frequently flooded. This deep, well drained, nearly level soil is on bottom lands (fig. 12). The areas are narrow and elongated and lie along meanders of streams in many places for several miles. Areas range from 20 to 200 acres or more.

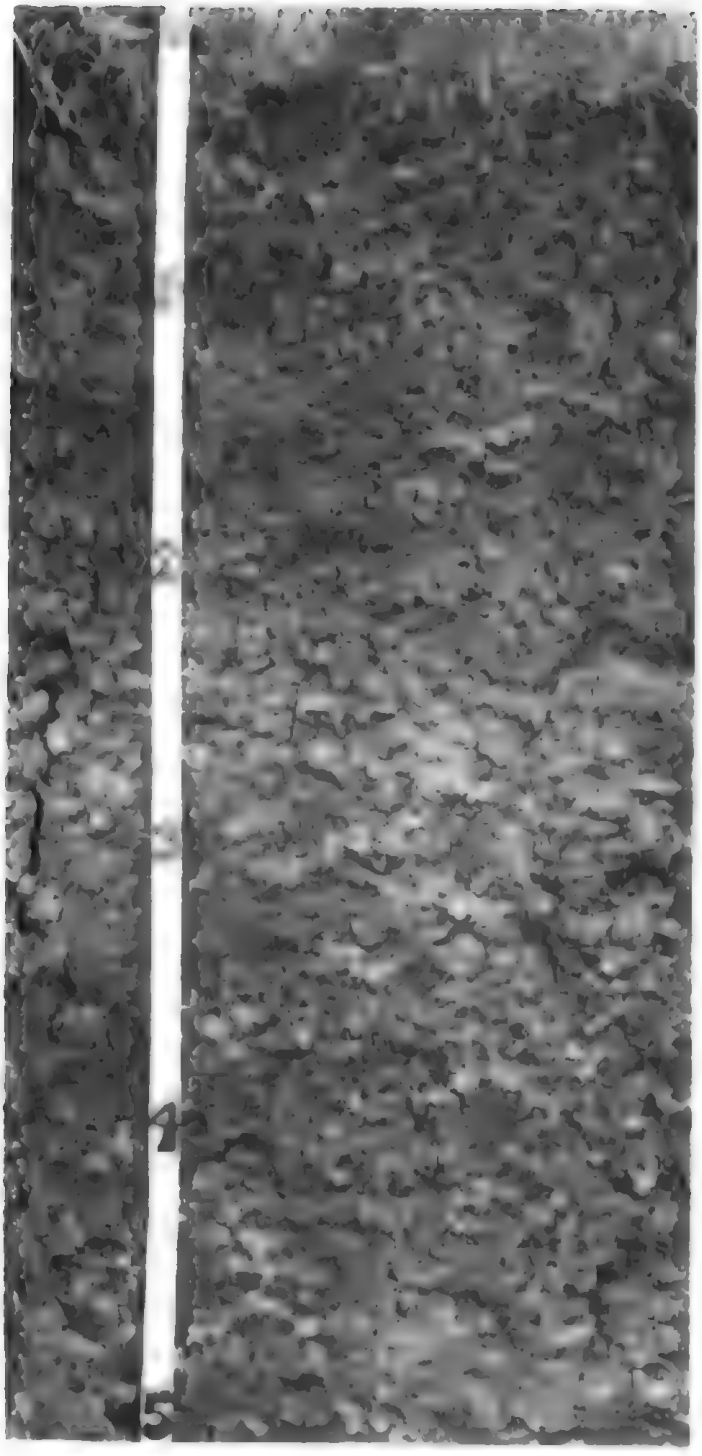


Figure 12.—Profile of Frio clay loam, frequently flooded. Note the blocky structure. Depths are shown in feet.

Typically, the surface layer is moderately alkaline, very dark grayish brown clay loam about 15 inches thick. From a depth of 15 to 30 inches is moderately alkaline, dark grayish brown silty clay loam. The next layer, from a depth of 30 to 50 inches, is moderately alkaline, grayish brown clay loam. Below that to a depth of 60 inches is moderately alkaline, grayish brown silty clay.

This soil is productive. Permeability is moderately slow, and available water capacity is high. Flooding usually occurs for brief periods once every 1 to 3 years in spring or fall. The hazard of soil blowing is slight. The hazard of water erosion is severe because of scouring during floods. The root zone is deep and is easily penetrated by plant roots. Tilth is good, and this soil can be worked throughout a wide range of moisture conditions. It is very sticky and plastic when wet, however.

Included with this soil in mapping are small areas of the closely similar Bosque and Santo soils. Also included is a soil that is similar to this Frio soil but is underlain by gravel and limestone fragments. A few small areas of soils that have a stony surface layer and some small areas of shallow soils are included. The closely similar bottom land soils are 10 to 30 acres and make up as much as 30 percent of some mapped areas. The stony or shallow contrasting soils are 2 to 5 acres and make up 5 to 10 percent of some mapped areas.

This Frio soil is mainly used as rangeland. The potential plant community is a tall grass savannah with a 10 to 15 percent canopy of woody plants. The predominant plants are—

- indiangrass—20 percent
- big bluestem—10 percent
- switchgrass—15 percent
- little bluestem—15 percent
- the rest is forbs, such as Maximilian sunflower, Englemann-daisy, trailing wildbean, Baldwin ironweed, catclaw sensitivebrier, trailing ratany, heath aster, gaura, and dalea; and woody plants, such as American elm, pecan, live oak, hackberry, cottonwood, bumelia, and elbowbush.

Indiangrass, big bluestem, and switchgrass are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. They are replaced by sideoats grama, dropseed, Texas wintergrass, and woody plants. Continued overgrazing causes a decrease of these plants, except for woody plants that continue to increase along with an invasion of western ragweed, nightshade, common bermudagrass, and buffalograss.

Potential for wildlife habitat is fair. This area is inhabited by deer, turkeys, dove, and quail. Turkeys commonly use the large trees for roosting. Many of the choice forage plants for deer and turkeys are produced on this soil. Excellent resting, nesting, and escape cover is also provided.

The Frio soil is not suited to use as cropland because of the hazard of flooding. It is suited to use as pastureland. Grasses, such as bermudagrass, kleingrass, and lovegrass, are adapted to this soil.

This soil is not suited to urban uses unless flooding is controlled. It is moderately well suited to most recreation uses. Flooding is a hazard, and the clayey texture is a limitation.

This soil is in capability subclass Vw and the Loamy Bottomland range site.

19—Hassee loam, 0 to 1 percent slopes. This deep, somewhat poorly drained, nearly level soil is in depressions. It is oval to oblong. The surface is mostly concave. Areas range from 15 to 80 acres.

Typically, the surface layer is grayish brown loam about 10 inches thick. From a depth of 10 to about 60 inches is clay that is very dark gray in the upper part, grading to gray in the middle part and to light brownish gray in the lower part. Reaction typically is neutral in the upper part and moderately alkaline in the lower part.

Permeability is very slow, and available water capacity is high. These concave areas receive runoff from higher elevations. Ponding occasionally occurs after heavy rainfall. Surface runoff is very slow. The hazards of water erosion and soil blowing are slight. When dry, this soil has a hard surface crust. It has poor tilth and can be worked well in a narrow range of moisture conditions. The root zone is deep, but the blocky clay lower layers severely restrict root penetration. This soil has a perched water table in the upper part during rainy periods.

Included with this soil in mapping are small areas of May and Thurber soils. May soils are on upper slopes. Thurber soils have plane surfaces. Also included are a few small areas of gently sloping Hassee soils. These included soils are mainly in areas of less than 5 acres and together make up less than 15 percent of any mapped area.

This Hassee soil is used mainly as rangeland, but a few small areas are cultivated. The main crops are small grain and forage sorghum. Because of the crusting and poor tilth of this soil, crop yields are low. Leaving plant residue on the surface helps to conserve moisture and maintain tilth. This soil is well suited to pasture. King Ranch bluestem is well adapted to this soil.

This soil is moderately well suited to use as rangeland. The potential plant community is a mid and short grass prairie. The predominant plants are—

- sideoats grama—20 percent
- vine-mesquite—20 percent
- Arizona cottontop—10 percent
- forbs, such as sagewort, heath aster, verbena, greenthread, and Maximilian sunflower—5 percent
- woody plants, such as lotebush and mesquite—5 percent
- the rest is dominantly blue grama, silver bluestem, Texas wintergrass, tall dropseed, buffalograss, curlymesquite, and white tridens.

Sideoats grama, vine-mesquite, blue grama, Arizona cottontop, and the perennial forbs are preferred by livestock; therefore they are grazed out of the community first if grazing is not controlled. These plants are replaced by silver bluestem, buffalograss, Texas wintergrass, tall dropseed, and perennial threeawn. Continued overgrazing causes a decline of most of these plants and an increase of lotebush along with an invasion of mesquite, pricklypear, tasajillo, annual lovegrasses, hairy tridens, and tumble lovegrass.

Potential for wildlife habitat is fair. This area is inhabited by dove, quail, rabbits, and deer. Ample food for birds is produced. Deer use the areas along major drainageways for supplemental grazing where adjacent protective cover is abundant.

This soil is poorly suited to most urban uses. Wetness, very slow permeability, and shrink-swell potential are limitations that are difficult to overcome. This Hassee soil is poorly suited to most recreation uses because of wetness and very slow permeability.

This soil is in capability subclass IIIw and the Claypan Prairie range site.

20—Hensley very stony clay loam, 0 to 5 percent slopes. This shallow, well drained, nearly level to gently sloping soil is on uplands. Areas are on broad ridgetops and range from 30 to more than 1,000 acres. Limestone fragments, 6 to 40 inches in diameter, cover 3 to 15 percent of the surface.

Typically, the surface layer is neutral, reddish brown very stony clay loam about 6 inches thick. From a depth of 6 to 15 inches is neutral, dark reddish brown clay loam. Below that is hard limestone bedrock.

Permeability is slow, and available water capacity is low. Runoff is medium. The hazard of water erosion is severe. The hazard of soil blowing is slight. The shallow depth to rock restricts root penetration.

Included with this soil in mapping are small areas of the closely similar Lindy, Hensley, and Palopinto soils. Also included in a few areas is a clayey soil that is underlain by limestone at a depth of 20 to 40 inches. Areas of the closely similar soils are as much as 30 acres and make up 10 to 40 percent of most mapped areas. Stony soils that are 20 to 40 inches deep make up 15 to 20 percent of some mapped areas.

This Hensley soil is poorly suited to use as cropland and pastureland. It is used as rangeland. It is moderately well suited to this use. The potential plant community is a prairie of mid and tall grasses interspersed with widely scattered mottes of live oak. The predominant plants are—

- indiangrass and big bluestem—20 percent
- little bluestem—30 percent
- sideoats grama, tall dropseed, cane bluestem and silver bluestem, Texas wintergrass, and vine-mesquite—30 percent
- forbs, such as bushsunflower, scurfpea, western ragweed, dotted gayfeather, dalea, prairie-clover, heath aster, Mexican sagewort, and Maximilian sunflower—5 percent
- woody plants, such as live oak, Texas oak, hackberry, and cedar elm—5 percent.

Other important plants are Canada wildrye, plains lovegrass, Texas cupgrass, buffalograss, curlymesquite, and fall witchgrass. These plants make up about 10 percent.

Indiangrass, big bluestem and little bluestem, and Canada wildrye are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. These plants are replaced by sideoats grama, tall dropseed, silver bluestem, Texas wintergrass, and buffalograss. Continued overgrazing causes a decline of these plants, except for Texas wintergrass, curlymesquite, and buffalograss. The remaining plants become low in vigor, and bare areas result. Other plants that invade are Texas grama, hairy tridens, red grama, tumblegrass, windmillgrass, annual grasses and forbs, juniper, mesquite, catclaw mimosa, lotebush, prairie coneflower, snow-on-the-mountain, and silverleaf nightshade.

Potential for wildlife habitat is fair. Quail prefer this area because it provides good cover and a variety of seed plants. Inadequate woody cover for escape may limit deer usage and movement until late in the evening and at night. An increase in woody cover can improve the habitat for dove and deer.

This Hensley soil is poorly suited to most urban and recreation uses. The depth to rock and stones on the surface are the main limitations (fig. 13).

This soil is in capability subclass VIs and the Redland range site.

21—Leeray clay, 0 to 1 percent slopes. This deep, well drained, nearly level soil is on uplands (fig. 14). Surfaces are plane. Areas range from 15 to 100 acres.

Typically, the surface layer is dark grayish brown clay about 10 inches thick. From a depth of 10 to 60 inches

Figure 13.—Hensley very stony clay loam, 0 to 5 percent slopes. Live oak trees are in the background.

Figure 14.—Limestone escarpment overlooking an area of Leeray clay, 0 to 1 percent slopes.

is clay that is grayish brown in the upper part, dark grayish brown in the middle part, and light yellowish brown in the lower part. This soil is calcareous and moderately alkaline throughout.

Permeability is very slow. Water enters rapidly through cracks in the dry soil but enters very slowly when the soil is moist. The available water capacity is high. Tilth is fair, and the surface layer can be worked well throughout a medium range in moisture conditions. The soil is very sticky and plastic when wet. Runoff is slow, and the hazard of water erosion is moderate. The hazard of soil blowing is slight. The root zone is deep, but the clay layers restrict some plant root penetration.

Included with this soil in some mapped areas are small areas of Hassee, Set, and Thurber soils. These soils are in positions similar to this Leeray soil and have no regular pattern of occurrence. These included soils are less than 15 acres and together make up less than 15 percent of any mapped area.

This Leeray soil is mainly used as cropland. It is well suited to the production of crops, such as small grain, cotton, and sorghum. Crop residue left on the surface helps to conserve moisture and maintain productivity. This soil is moderately well suited to use as pastureland. King Ranch bluestem and kleingrass are adapted to this soil.

Rangeland production is high if proper management is used. This soil is well suited to use as rangeland. The potential plant community is a prairie of tall and mid grasses. The predominant plants are—

- big bluestem and switchgrass—15 percent
- little bluestem—25 percent
- indiangrass—10 percent
- sideoats grama—10 percent.

Other important plants are—

- cane bluestem and silver bluestem—5 percent
- vine-mesquite—5 percent
- Texas wintergrass—5 percent
- the rest is forbs, such as Engelmann-daisy, bundleflower, prairie-clover, Maximilian sunflower, sensitivebrier, and halfshrub sundrop.

Big bluestem, switchgrass, indiangrass, and many perennial forbs are preferred by livestock; therefore, they are grazed out if grazing is not controlled. These plants are replaced by an increase of little bluestem, sideoats grama, cane and silver bluestem, vine-mesquite, and Texas wintergrass. Continued heavy grazing causes an invasion of threeawn, Texas grama, annual grasses and weeds, lotebush, pricklypear, tasajillo, juniper, and mesquite.

The potential for wildlife habitat is fair. This soil is inhabited by deer, dove, and quail. Several of the forbs and grasses provide seed for game birds and animals. A good selection of forbs for deer forage is available, but little cover and protection for escape and resting are provided.

This Leeray soil is poorly suited to most urban uses. The shrink-swell potential and very slow permeability are limitations that are very difficult to overcome. The soil is poorly suited to recreation uses. The clayey texture is the main limitation.

This soil is in capability subclass IIIs and the Clay Loam range site.

22—Leeray clay, 1 to 3 percent slopes. This deep, well drained, gently sloping soil is on uplands. Surfaces are plane. This soil has gilgai microrelief. It has deep cracks when dry. Areas range from 15 to 1,000 acres and are generally oval.

Typically, the surface layer is moderately alkaline, dark grayish brown clay about 8 inches thick. From a depth of 8 to 60 inches is moderately alkaline clay that is very dark grayish brown in the upper part, grayish brown in the middle part, and olive brown in the lower part.

This soil is productive. Permeability is very slow, and available water capacity is high. When the soil is dry, water enters rapidly through cracks. When the soil is moist, water enters very slowly. Runoff is medium. The hazard of water erosion is severe, and the hazard of soil blowing is slight. The soil is very sticky and plastic when wet. It can be worked throughout a wide range of moisture conditions. The root zone is deep, but clay layers restrict root penetration.

Included with this soil in mapping are small areas of Set, Thurber, Truce, and Velow soils. Set, Truce, and Velow soils are on upper slopes. Thurber soils are on plane surfaces. Also included are small areas of sloping Leeray soils and a few small rock outcrops along ridges. The included soils are 3 to 10 acres and make up less than 15 percent of any mapped area.

This Leeray soil is mainly used as cropland. Row crops that include sorghum, cotton, and small grain are well suited. Using terraces and contour farming help to control erosion. Leaving crop residue on the soil helps to conserve moisture, reduce soil temperature, and maintain soil productivity. This soil is moderately well suited to use as pastureland. Kleingrass and King Ranch bluestem are adapted.

Rangeland production is high if proper management is used. This soil is well suited to use as rangeland. The potential plant community is a prairie of tall and mid grasses. The predominant plants are—

- big bluestem and switchgrass—15 percent
- little bluestem—25 percent
- indiangrass—10 percent
- sideoats grama—10 percent.

Other important plants are—

- cane bluestem and silver bluestem—5 percent
- vine-mesquite—5 percent
- Texas wintergrass—5 percent
- forbs, such as Engelmann-daisy, bundleflower, prairie-clover, Maximilian sunflower, sensitivebrier, and halfshrub sundrop, make up the rest.

Big bluestem, switchgrass, indiangrass, and many perennial forbs are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. These plants are replaced by an increase of little bluestem, sideoats grama, cane bluestem, silver bluestem, vine-mesquite, and Texas wintergrass. Continued overgrazing causes a decline of all of these plants and an invasion of threeawn, Texas grama, annual grasses and weeds, lotebush, pricklypear, tasajillo, juniper, and mesquite.

Potential for wildlife habitat is fair. This area is inhabited by deer, dove, and quail. Several of the forbs and grasses provide seed for game birds and animals. A good selection of forbs for deer forage is provided but little cover and protection for escape and resting.

This Leeray soil is poorly suited to most urban and recreation uses. Shrink-swell potential, very slow permeability, and the clayey texture are limitations.

This soil is in capability subclass IIIe and the Clay Loam range site.

23—Leeray clay, 3 to 5 percent slopes. This deep, well drained, gently sloping soil is in upland valleys, on

hillsides, and in divides. Areas are elongated and range from 15 to 200 acres. This soil has a gilgai microrelief. The highs and lows are parallel and oriented downslope in a "wagon wheel" effect.

Typically, the surface layer is moderately alkaline, dark grayish brown clay about 12 inches thick. From a depth of 12 to 40 inches is moderately alkaline, dark grayish brown clay. Below that to a depth of 60 inches is moderately alkaline, grayish brown clay.

This soil is productive. Permeability is very slow, and available water capacity is high. When the soil is dry, water enters rapidly through deep cracks. When the soil is moist, water enters very slowly. Runoff is rapid. The hazard of water erosion is severe, and the hazard of soil blowing is slight. The soil is very sticky and plastic when wet. It can be worked throughout a wide range of moisture conditions. The root zone is deep, but clay layers restrict root penetration.

Included with this soil in mapping are small areas of Set, Truce, and Velow soils. These soils are on upper slopes. Also included are small areas of less sloping Leeray soils. Rock outcrops are in places. These included soils are less than 10 acres and together make up less than 15 percent of any mapped area.

This Leeray soil is mainly used as rangeland (fig. 15) and is well suited to this use. The potential plant

Figure 15.—Chaining large mesquite trees on Leeray clay, 3 to 5 percent slopes. This is a form of brush control.

community is a prairie of tall and mid grasses. The predominant plants are—

- big bluestem and switchgrass—15 percent
- little bluestem—25 percent
- indiangrass—10 percent
- sideoats grama—10 percent.

Other important plants are—

- cane bluestem and silver bluestem—5 percent
- vine-mesquite—5 percent
- Texas wintergrass—5 percent
- forbs, such as Engelmann-daisy, bundleflower, prairie-clover, Maximilian sunflower, sensitivebrier, and halfshrub sundrop, make up the rest.

Big bluestem, switchgrass, indiangrass, and many perennial forbs are preferred by livestock; therefore, they are grazed out if grazing is not controlled. These plants are replaced by little bluestem, sideoats grama, cane bluestem, silver bluestem, vine-mesquite, and Texas wintergrass. Continued overgrazing causes a decline of all of these plants and an invasion of threeawn, Texas grama, annual grasses and weeds, lotebush, pricklypear, tasajillo, juniper, and mesquite.

Potential for wildlife habitat is fair. This area is inhabited by deer, dove, and quail. Several of the forbs and grasses provide seed for game birds and animals. A good selection of forbs for deer forage is provided but little cover and protection for escape and resting.

This soil is moderately well suited to use as cropland. Row crops including sorghum and small grain are grown. Using terraces and contour farming help to control erosion. Leaving crop residue on the soil helps to conserve moisture, reduce soil temperature, and maintain productivity. This soil is moderately well suited to use as pastureland. Kleingrass and King Ranch bluestem are adapted.

This Leeray soil is poorly suited to most urban and recreation uses. Shrink-swell potential, the clayey surface layer, and very slow permeability are the main limitations.

This soil is in capability subclass IVe and the Clay Loam range site.

24—Lindy clay loam, 1 to 3 percent slopes. This moderately deep, well drained, gently sloping soil is on upland ridgetops (fig. 16). Areas are irregular to rounded in shape and range from 15 to 200 acres.

Typically, the surface layer is slightly acid, brown clay loam about 8 inches thick. From a depth of 8 to 30 inches is mildly alkaline, reddish brown clay loam. Below that is hard limestone bedrock.

Permeability is slow, and available water capacity is low. Tilth is fair, and the soil can be worked well in a narrow range of moisture conditions. Runoff is medium. The hazard of water erosion is severe, and the hazard of soil blowing is slight. The root zone is moderately deep; however, the clayey lower layers restrict root penetration.

Included with this soil in mapping are small areas of Hensley, Leeray, and Palopinto soils. Hensley and Palopinto soils border sloping to moderately steep areas. Leeray soils are on lower concave spots. Also included are some small areas of Leeray soils that have a stony surface layer. These included soils are less than 10 acres and together make up less than 15 percent of any mapped area.

This Lindy soil is mainly used as rangeland for which it is well suited. The potential plant community is a tall grass prairie interspersed with mid grasses. The predominant plants are—

- big bluestem, indiangrass, and little bluestem—55 percent.

Other important plants are—

- sideoats grama, tall dropseed, cane bluestem, silver bluestem, and vine-mesquite—15 percent
- Texas wintergrass and Canada wildrye—10 percent
- plains lovegrass, white tridens, and Texas cupgrass—5 percent
- buffalograss, curlymesquite, fall witchgrass, and perennial threeawn—5 percent
- forbs, such as compassplant, Maximilian sunflower, bushsunflower, western ragweed, halfshrub sundrop, bundleflower, dalea, prairie-clover, scurfpea, and gaura—10 percent.

Big bluestem, little bluestem, indiangrass, and wildrye are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. These plants are replaced by sideoats grama, tall dropseed, silver bluestem, Texas wintergrass, and buffalograss. Continued overgrazing causes a decline in these plants and an accompanying invasion of Texas grama, hairy tridens, red grama, tumblegrass, windmillgrass, annual bromegrasses, juniper, mesquite, pricklypear, catclaw, agarito, elbowbush, lotebush, prairie coneflower, and many other weedy forbs.

The plant food and cover on this soil provide good habitat for quail. Inadequate woody cover for escape may limit deer usage and movement to late in the evening and at nighttime. However, lower site conditions may increase mesquite canopy cover up to 45 percent and improve habitat for dove and deer.

This soil is moderately well suited to use as cropland. The major crops are sorghum and small grain. Using terraces and contour farming help to control erosion. Leaving crop residue on the soil helps to conserve moisture, reduce runoff, and maintain soil productivity. This soil is well suited to use as pastureland. Kleingrass and King Ranch bluestem are adapted to this soil.

This Lindy soil is moderately well suited to most urban and recreation uses. Shrink-swell potential and slow permeability are limitations that can be overcome by using proper designs and careful installation procedures.

Figure 16.—Cattle grazing on an area of Lindy clay loam, 1 to 3 percent slopes.

This soil is in capability subclass IIIe and the Deep Redland range site.

25—May very fine sandy loam, 0 to 1 percent slopes. This deep, well drained, nearly level soil is on stream terraces and in valleys. Areas are long and narrow and range from 15 to 200 acres.

Typically, the surface layer is pale brown very fine sandy loam about 8 inches thick. From a depth of 8 to 18 inches is grayish brown very fine sandy loam. At a depth of 18 to 48 inches is sandy clay loam that is yellowish brown in the upper part and light yellowish brown in the lower part. Below that to a depth of 60 inches is very pale brown fine sandy loam. Reaction is neutral in the upper part and moderately alkaline in the lower part.

This is a productive soil that responds well to fertilization. Permeability is moderate, and available water capacity is medium. Runoff is slow. The hazards of water erosion and soil blowing are moderate. This soil receives additional moisture as runoff from soils that are higher on the landscape. This soil can be worked throughout a wide range of moisture conditions. The root zone is deep and is easily penetrated by roots.

Included with this soil in mapping are small areas, less than 5 acres, of Santo and Velow soils. Santo soils are on flood plains. Velow soils are on low knolls. Also included are a few small areas of gently sloping May fine sandy loam. These included soils are as much as 5 acres and together make up less than 10 percent of any mapped area.

This May soil is mainly used as cropland and is well suited to sorghum, truck crops, pecan orchards, and small grain. Leaving crop residue on the soil helps to conserve moisture, reduce soil temperature, and maintain soil tilth and productivity. This soil is well suited to use as pastureland. Coastal bermudagrass and kleingrass are the main grasses grown.

This soil is well suited to use as rangeland. The potential plant community is a post oak savannah with an understory of tall and mid grasses. The predominant plants are—

- little bluestem—30 percent

- big bluestem and sand bluestem—10 percent
- indiangrass—10 percent
- sideoats grama—10 percent
- forbs, such as yellow neptunia, scurfpea, western ragweed, Englemann-daisy, dotted gayfeather, bundleflower, dalea, and prairie-clover—10 percent
- post oak—10 percent.

Other important plants are—

- cane bluestem and silver bluestem—5 percent
- Scribner panicum—5 percent
- Texas wintergrass—5 percent
- Arizona cottontop and sand lovegrass—5 percent
- small amounts of blackjack oak, elm, pricklyash, bumelia, hackberry, sumac, live oak, elbowbush, greenbrier, and plums.

Big bluestem, indiangrass, switchgrass, and sand lovegrass are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. They are replaced by little bluestem and sideoats grama. Continued overgrazing causes a decline in these plants. Silver bluestem, hooded windmillgrass, and hairy grama would then increase. Further heavy grazing causes an invasion of threeawn, dropseed, red lovegrass, annual grasses, skunkbush sumac, and post oak. Mesquite, juniper, and catclaw can eventually take over and shade out most grasses.

Potential for wildlife habitat is good. This area is inhabited by deer, dove, quail, squirrels, and turkeys. Several of the woody plants, forbs, and grasses provide good cover, browse, mast, and seeds for game birds and animals.

This May soil is well suited to most urban and recreation uses.

This soil is in capability class I and the Sandy Loam range site.

26—Dumps, mine. This map unit consists of waste material from coal mines that were in operation during the early part of the 20th century. The material consists mainly of fragments of coal, rock, and shale. Most of these mines were in the southwestern part of the county. The dumps are mostly oval, 10 to 75 feet high, and 5 to 15 acres.

These areas support little or no vegetation and do not have significant agricultural use. Reaction is extremely acid.

Some of the material from the dumps has been used for road fill, and some has been used for making brick and tile.

These areas generally are not suited to wildlife habitat or to urban or recreation uses.

This map unit is not in a capability subclass or range site.

27—Minwells fine sandy loam, 1 to 3 percent slopes. This deep, well drained, gently sloping soil is on high stream terraces along the Brazos River and other major streams in the county. Surfaces are plane to convex. Areas are irregular in shape and range from 15 to 200 acres.

Typically, the surface layer is light reddish brown fine sandy loam about 6 inches thick. From a depth of 6 to 17 inches is reddish brown clay. The next layer, to a depth of 46 inches, is red clay loam. At a depth of 46 to 57 inches is yellowish red sandy clay loam. From 57 to 71 inches is yellowish red gravelly sandy clay loam. The underlying layer to a depth of 80 inches is red very gravelly sand. Reaction typically is slightly acid in the upper part and moderately alkaline in the lower part.

Permeability is slow, and available water capacity is medium. The surface is very hard and crusty when this soil is dry. Runoff is medium. The hazards of water erosion and soil blowing are moderate. Tilth is good, but this soil is worked in a narrow range of moisture conditions. The root zone is deep, but the clayey lower layers restrict some root penetration. This soil responds well to fertilization.

Included with this soil in mapping are small spots of Bastrop soils and a soil that is similar to this Minwells soil except the gravelly underlying material is deeper than 80 inches. Also included are some small gravel pits. These included soils and miscellaneous areas are mostly on lower slopes and are less than 15 acres. They make up less than 15 percent of any mapped area.

This Minwells soil is mainly used as rangeland. The potential plant community is a post oak savannah with an understory of tall and mid grasses. The predominant plants are—

- little bluestem—30 percent
- big bluestem and sand bluestem—10 percent
- indiangrass—10 percent
- sideoats grama—10 percent
- forbs, such as yellow neptunia, scurfpea, western ragweed, Englemann-daisy, dotted gayfeather, bundleflower, dalea, and prairie-clover—10 percent
- post oak—10 percent.

Other important plants are—

- cane bluestem and silver bluestem—5 percent
- Scribner panicum—5 percent
- Texas wintergrass—5 percent
- Arizona cottontop and sand lovegrass—5 percent
- small amounts of blackjack oak, elm, pricklyash, bumelia, hackberry, sumac, live oak, elbowbush, greenbrier, and plums.

Big bluestem, indiangrass, switchgrass, and sand lovegrass are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. These plants are replaced by little bluestem and sideoats grama. Continued overgrazing causes these plants to be grazed out. Silver bluestem, hooded windmillgrass, and hairy grama would then increase. Further heavy grazing causes a decline in all of these plants and an invasion of threeawn, dropseed, red lovegrass, annual grasses, skunkbush sumac, and post oak. Mesquite, juniper, and

catclaw can eventually take over and shade out most grasses.

Potential for wildlife habitat is good. This area is inhabited by deer, dove, quail, squirrels, and turkeys. Several of the woody plants, forbs, and grasses provide good cover, browse, mast, and seeds for game birds and animals.

This soil is well suited to use as cropland. Sorghum, small grain, truck crops, and peaches are grown. Using terraces and contour cultivating help to control erosion. Leaving crop residue on the soil helps to conserve moisture, reduce runoff, and maintain productivity and tilth. Pasture production is high if proper management is used. Bermudagrass, kleingrass, and lovegrass are grown on this soil.

This soil is moderately well suited to most urban uses. Slow permeability is a limitation for septic tank filter fields, but it can be overcome by using proper design and careful installation procedures. The moderate shrink-swell potential should be considered in construction. This soil is well suited to recreation uses.

This soil is in capability subclass IIe and the Sandy Loam range site.

28—Minwells fine sandy loam, 3 to 5 percent slopes. This deep, well drained, gently sloping soil is on high stream terraces along the Brazos River and the major streams in the county. Surfaces are plane to convex. Areas are irregular in shape and range from 15 to 100 acres.

Typically, the surface layer is slightly acid, light brown fine sandy loam about 10 inches thick. From a depth of 10 to 20 inches is slightly acid, reddish brown sandy clay. At a depth of 20 to 30 inches is slightly acid, reddish brown clay. The underlying layer from a depth of 30 to 60 inches is neutral, reddish brown gravelly sandy clay loam.

Permeability is slow, and available water capacity is medium. The surface layer is very hard and crusty when this soil is dry. Runoff is rapid, and the hazard of water erosion is severe. The hazard of soil blowing is moderate. This soil is easily tilled in a narrow range of moisture conditions. The root zone is deep, but the clayey lower layers restrict some root penetration. This soil responds well to fertilization.

Included with this soil in mapping are small areas of Bastrop, Decordova, and Truce soils. Bastrop and Decordova soils are on slightly lower slopes. Truce soils are on hillsides. Also included are some small gravel pits. These included soils and miscellaneous areas are less than 5 acres and together make up less than 10 percent of any mapped area.

This Minwells soil is mainly used as rangeland, for which it is well suited. The potential plant community is a post oak savannah with an understory of tall and mid grasses. The predominant plants are—

- little bluestem—30 percent
- big bluestem and sand bluestem—10 percent
- indiangrass—10 percent
- sideoats grama—10 percent
- forbs, such as yellow neptunia, scurfpea, western ragweed, Englemann-daisy, dotted gayfeather, bundleflower, dalea, and prairie-clover—10 percent
- post oak—10 percent.

Other important plants are—

- cane bluestem and silver bluestem—5 percent
- Scribner panicum—5 percent
- Texas wintergrass—5 percent
- Arizona cottontop and sand lovegrass—5 percent
- small amounts of blackjack oak, elm, pricklyash, bumelia, hackberry, sumac, live oak, elbowbush, greenbrier, and plums.

Big bluestem, indiangrass, switchgrass, and sand lovegrass are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. They are replaced by little bluestem and sideoats grama. Continued overgrazing causes these plants to be grazed out. Silver bluestem, hooded windmillgrass, and hairy grama would then increase. Further heavy grazing causes an invasion of threeawn, dropseed, red lovegrass, annual grasses, skunkbush sumac, and post oak. Mesquite, juniper, and catclaw can eventually take over and shade out most grasses.

Potential for wildlife habitat is good. This area is inhabited by deer, dove, quail, squirrels, and turkeys. Several of the woody plants, forbs, and grasses provide good cover, browse, mast, and seeds for game birds and animals.

This soil is moderately well suited to use as cropland. Sorghum, small grain, truck crops, and peaches are adapted to this soil. Using terraces and contour cultivating help to control erosion. Leaving crop residue on the soil helps to conserve moisture, reduce runoff, and maintain productivity and tilth. This soil is well suited to use as pastureland. Bermudagrass, kleingrass, and lovegrass are adapted to this soil.

This Minwells soil is moderately well suited to most urban and recreation uses. Slow permeability is a limitation for septic tank filter fields, but it can be overcome by using proper design and careful installation procedures. The moderate shrink-swell potential should be considered in construction.

This soil is in capability subclass IIIe and the Sandy Loam range site.

29—Minwells fine sandy loam, 1 to 5 percent slopes, eroded. This deep, well drained, gently sloping soil is on eroded, high stream terraces of the Brazos River and other major streams. Slopes are mostly convex. They average about 3 percent. Areas range from 15 to 100 acres. In about half of these areas, there are gullies about 50 to 250 feet apart. These gullies are 5 to 15 feet wide, 1 to 4 feet deep, and 30 to 400 feet long. Most of them can be crossed by farm machinery. In the other half of the areas, few or no gullies are

present; however, sheet erosion has removed 50 to 75 percent of the surface layer.

Typically, the surface layer is slightly acid, light brown fine sandy loam about 6 inches thick. From a depth of 6 to 34 inches is slightly acid clay that is reddish brown in the upper part and yellowish red in the lower part. The underlying layer to a depth of 60 inches is neutral red clay loam.

Permeability is slow, and available water capacity is medium. The surface layer is very hard and crusty when this soil is dry. Tilth is good when the soil is cultivated in a narrow range of moisture conditions. Runoff is rapid, and the hazard of water erosion is severe. The hazard of soil blowing is moderate. The root zone is deep, but the clayey lower layers restrict some root penetration. The natural fertility has been lowered because of erosion. The soil responds well to fertilization.

Included with this soil in mapping are small areas of Bastrop, Decordova, and Truce soils. Bastrop and Decordova soils are in slightly lower positions on the landscape. Truce soils are on slopes of ridges and hills. Also included are small areas of noneroded Minwells soils. In some areas are small gravel pits. The included soils and miscellaneous areas are as much as 10 acres, and together make up less than 15 percent of any mapped area.

This Minwells soil is mainly used as rangeland and is well suited to this use. The potential plant community is a post oak savannah with an understory of tall and mid grasses. The predominant plants are—

- little bluestem—30 percent
- big bluestem and sand bluestem—10 percent
- indiangrass—10 percent
- sideoats grama—10 percent
- forbs, such as yellow neptunia, scurfpea, western ragweed, Englemann-daisy, dotted gayfeather, bundleflower, dalea, and prairie-clover—10 percent
- post oak—10 percent.

Other important plants are—

- cane bluestem and silver bluestem—5 percent
- Scribner panicum—5 percent
- Texas wintergrass—5 percent
- Arizona cottontop and sand lovegrass—5 percent
- small amounts of blackjack oak, elm, pricklyash, bumelia, hackberry, sumac, live oak, elbowbush, greenbrier, and plums.

Big bluestem, indiangrass, switchgrass, and sand lovegrass are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. They are replaced by little bluestem and sideoats grama. Continued overgrazing causes these plants to be grazed out. Silver bluestem, hooded windmillgrass, and hairy grama would then increase. Further heavy grazing causes an invasion of threeawn, dropseed, red lovegrass, annual grasses, skunkbush sumac, and post oak. Mesquite, juniper, and catclaw can eventually take over and shade out most grasses.

Potential for wildlife habitat is good. This area is inhabited by deer, dove, quail, squirrels, and turkeys. Several of the woody plants, forbs, and grasses provide good cover, browse, mast, and seeds for game birds and animals.

This soil is moderately well suited to use as cropland. Sorghum, small grain, truck crops, and peaches are adapted to this soil. Using terraces and contour cultivating help to control erosion. Leaving crop residue on the soil helps to conserve moisture, reduce runoff, and maintain productivity and tilth. This soil is well suited to pasture production. Bermudagrass, kleingrass, and lovegrass are adapted to this soil.

This soil is moderately well suited to most urban uses. Slow permeability is a limitation for septic tank filter fields, but it can be overcome by using proper design and careful installation procedures. The moderate shrink-swell potential should be considered in construction. This soil is well suited to recreation uses.

This soil is in capability subclass IIIe and the Sandy Loam range site.

30—Owens clay, 1 to 5 percent slopes. This shallow, well drained, gently sloping soil is on low knolls and foot slopes. Areas are irregular in shape and range from 15 to 40 acres.

Typically, the surface layer is moderately alkaline, light olive brown clay about 8 inches thick. From a depth of 8 to 18 inches is moderately alkaline, light olive brown clay. The underlying layer to a depth of 40 inches is moderately alkaline, olive yellow, massive shaly clay.

Permeability is very slow, and available water capacity is very low. The surface is very hard and crusty when the soil is dry and sticky and plastic when the soil is wet. Runoff is rapid, and the hazard of water erosion is severe. The hazard of soil blowing is slight. This soil can be worked well in a narrow range of moisture conditions. The root zone is shallow, and root penetration is restricted by the clayey texture.

Included with this soil in mapping are small areas of Set and Truce soils. These soils are on lower slopes and are mostly less than 5 acres. They make up less than 15 percent of any mapped area.

This Owens soil is mainly used as rangeland. Range forage yields are low. The potential plant community is a mid and short grass prairie with scattered woody plants. The predominant plants are—

- sideoats grama—30 percent
- cane bluestem and silver bluestem—15 percent
- buffalograss—10 percent
- vine-mesquite—10 percent
- forbs, such as western ragweed, sagewort, dalea, bundleflower, and Englemann-daisy—5 percent
- woody plants, such as ephedra, hackberry, live oak, agarito, and catclaw—5 percent.

Other plants are—

- curlymesquite—5 percent
- Texas wintergrass—5 percent

- Arizona cottontop—5 percent
- tall dropseed—5 percent
- hairy grama and rough tridens—5 percent.

Sideoats grama, vine-mesquite, and cane bluestem are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. These plants are replaced by buffalograss and curlymesquite. Continued overgrazing causes these plants to lose their vigor and thin out, but rarely are they completely grazed out. Eventually, with loss of cover, the site is invaded by annual forbs and grasses, mesquite, lotebush, juniper, pricklypear, and tasajillo.

Potential for wildlife habitat is poor. Quail and deer are in some areas, however. If the area is invaded by brush, protective cover will be available for deer.

This soil is poorly suited to use as cropland. The scarce amount of water held available for plants and the shallow root zone are limitations for this use. Small grain and forage sorghum are grown in some areas. Using terraces and contour cultivating help to control erosion. Leaving crop residue on the soil helps to conserve moisture, reduce runoff, and maintain productivity. Pasture production is low. King Ranch bluestem is adapted to this soil.

This Owens soil is poorly suited to most urban and recreation uses. Shrink-swell potential, the clayey surface layer, and the shallow depth to shaly clay are limitations that are difficult to overcome.

This soil is in capability subclass IVe and the Shallow Clay range site.

31—Owens very stony clay, 1 to 8 percent slopes. This shallow, well drained, gently sloping to sloping soil is on stony hillsides and foot slopes. Areas are irregular in shape and follow the contour of hills and ridges. Areas range from 15 to 50 acres. Sandstone, limestone, and ironstone fragments, 6 to 20 inches in diameter, cover 3 to 15 percent of the surface. In about half of the areas, there are gullies 1 foot or 2 feet deep and 2 to 8 feet wide in 30- to 80-foot intervals. The gullies are 30 to 500 feet long. In the other half of these areas, few or no gullies are present. Sheet erosion, however, has thinned the surface layer.

Typically, the surface layer is moderately alkaline, light olive brown very stony clay about 4 inches thick. From a depth of 4 to 12 inches is moderately alkaline, light yellowish brown clay. The underlying layer to a depth of 20 inches is moderately alkaline, light yellowish brown shaly clay.

Permeability is very slow, and available water capacity is very low. The surface is very hard and crusty when the soil is dry. Runoff is rapid, and the hazard of water erosion is severe. The hazard of soil blowing is slight. The root zone is shallow.

Included with this soil in mapping are small areas of Bonti, Set, and Truce soils. These soils are 1 acre to 5 acres and make up as much as 10 percent of a mapped area. Also included are a few small areas of nonstony Owens soils and a few spots of extremely stony Owens soils. These closely similar soils make up less than 30 percent of any mapped area.

This Owens soil is mainly used as rangeland. Forage production is low. The potential plant community is a mid and short grass prairie with scattered woody plants. The predominant plants are—

- sideoats grama—30 percent
- cane bluestem and silver bluestem—15 percent
- buffalograss—10 percent
- vine-mesquite—10 percent
- forbs, such as western ragweed, sagewort, dalea, bundleflower, and Engelmann-daisy—5 percent
- woody plants, such as ephedra, hackberry, live oak, agarito, and catclaw—5 percent.

Other plants are—

- curlymesquite—5 percent
- Texas wintergrass—5 percent
- Arizona cottontop—5 percent
- tall dropseed—5 percent
- hairy grama and rough tridens—5 percent.

Sideoats grama, vine-mesquite, and cane bluestem are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. These plants are replaced by buffalograss and curlymesquite. Continued overgrazing causes these plants to lose their vigor and thin out, but they rarely are completely grazed out. Eventually, with loss of cover, the site is invaded by annual forbs and grasses, mesquite, lotebush, juniper, pricklypear, and tasajillo.

Potential for wildlife habitat is poor. Quail and deer, however, are in some areas. If the area is invaded by brush, protective cover will be available for deer.

This soil is poorly suited to use as cropland and pastureland.

This Owens soil is poorly suited to recreation and urban uses. Stones, slope, shrink-swell potential, the clayey texture, and depth to shaly clay are limitations.

This soil is in capability subclass VIs and the Shallow Clay range site.

32—Owens very stony clay, 8 to 40 percent slopes. This shallow, well drained, strongly sloping to steep soil is on very stony ridges and hills. Limestone and sandstone fragments, 6 to 30 inches in diameter, cover 3 to 15 percent of the soil surface. Shallow gullies that are 1 foot to 3 feet deep, 6 to 15 feet wide, and 50 to 100 feet apart have been formed by erosion. A few exposed areas of shale as much as 1 acre are present. Areas are irregular in shape and generally are on south-facing slopes. They range from 20 to 500 acres.

Typically, the surface layer is moderately alkaline, brown very stony clay about 4 inches thick. From a depth of 4 to 16 inches is moderately alkaline, light olive brown clay. The underlying layer to a depth of 40 inches is moderately alkaline, pale olive shaly clay.

Permeability is very slow, available water capacity is very low, and runoff is rapid. The root zone is shallow.

The hazard of water erosion is severe, and the hazard of soil blowing is slight.

Included with this soil in mapping are 1- to 3-acre areas of exposed shale, extremely stony soils, and rock outcrops. Also included in some areas are small spots of soils that are closely similar to the Owens soil except they are noncalcareous to the surface or have shale at a depth of more than 20 inches. These closely similar soils make up less than 30 percent of any mapped area. One to 3-acre spots of stony Truce and Shatruce soils are included in some areas. The Owens soil and closely similar soils comprise more than 70 percent of this map unit.

This Owens soil is mainly used as rangeland. Forage production is low. The potential plant community is a live oak savannah with mid and short grasses. The predominant plants are—

- sideoats grama—30 percent
- cane bluestem and silver bluestem—15 percent
- buffalograss—10 percent
- forbs, such as western ragweed, sagewort, bundleflower, and Engelmann-daisy—5 percent
- woody plants, such as live oak—10 percent.

Other important plants are—

- vine-mesquite—5 percent
- curlymesquite—5 percent
- Texas wintergrass—5 percent
- Arizona cottontop—5 percent
- tall dropseed—5 percent
- hairy grama and rough tridens—5 percent
- a trace of hackberry, ephedra, agarito, and catclaw.

Sideoats grama, vine-mesquite, cane blustem, silver bluestem, and some forbs are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. These plants are replaced by buffalograss and curlymesquite. These plants become much less vigorous with continued overgrazing, but they are seldom grazed out. Mesquite, lotebush, juniper, pricklypear, tasajillo, and annuals invade under these conditions.

This soil is poorly suited to use as cropland and pastureland.

Potential for wildlife habitat is poor because food and cover plants are inadequate in most places.

This Owens soil is poorly suited to recreation and urban uses. Slopes, stones, and shallow soil depth are limitations.

This soil is in capability subclass VIIs and the Rocky Hill range site.

33—Palopinto extremely stony clay loam, 1 to 8 percent slopes. This shallow, well drained, gently sloping to sloping soil is on upland ridgetops. Limestone fragments, 6 to 30 inches in diameter, cover about 30 percent of the surface. Areas are irregular in shape and range from 20 to 1,000 acres or more.

Typically, the surface layer is moderately alkaline, dark grayish brown, extremely stony clay loam about 12 inches thick. It contains about 35 to 85 percent limestone fragments. The underlying layer below a depth of 12 inches is fractured limestone bedrock.

This soil is well drained. Surface runoff is medium to rapid. Permeability is moderate, and available water capacity is very low. The hazards of water erosion and soil blowing are slight.

Included with this soil in mapping are small areas of Hensley, Leeray, and Set soils and a soil closely similar to the Palopinto soil except that it is 20 to 30 inches deep to limestone. The closely similar soils, including Hensley soils, are as much as 40 acres and make up 30 percent of some large areas. Leeray soils are in concave areas, and Set soils are along slopes. These soils make up about 15 percent of some mapped areas.

This Palopinto soil is poorly suited to use as cropland or pastureland because of the shallow rooting depth and stony surface layer.

This soil is mainly used as rangeland (fig. 17), and it is moderately well suited to this use. The potential plant community is a tall and mid grass, live oak savannah. The predominant plants are—

- little bluestem—25 percent
- indiangrass and big bluestem—10 percent
- forbs, such as Maximilian sunflower, bushsunflower, Engelmann-daisy, penstemon, gayfeather, bundleflower, sensitivebrier, yellow neptunia, dalea, prairie-clover, western indigo, and western ragweed—5 percent
- woody plants, such as live oak, Texas oak, cedar elm, and hackberry—10 percent.

Other important plants are—

- sideoats grama, tall dropseed, cane bluestem, silver bluestem, and vine-mesquite—15 percent
- Texas wintergrass, Canada wildrye, and Virginia wildrye—10 percent
- Texas cupgrass, plains lovegrass, perennial threeawn, buffalograss, and curlymesquite—25 percent
- minor amounts of shin oak, greenbrier, sumac, and elbowbush.

Big bluestem, indiangrass, little bluestem, Canada wildrye, and the palatable forbs are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. These plants are replaced by sideoats grama, cane bluestem, silver bluestem, Texas wintergrass, and buffalograss. Continued overgrazing causes a decline of the tall and mid grasses and the better forbs. Buffalograss and Texas wintergrass persist; however, with continued heavy grazing, they will thin out and leave bare areas that have low vigor.

During this time shin oak, Ashe juniper, agarito, mesquite, pricklypear, tasajillo, prairie coneflower, croton, hairy tridens, Texas grama, tumblegrass, red threeawn, and other annual forbs and grasses invade the site.

Potential for wildlife habitat is fair. This area is inhabited by deer, dove, turkeys, and quail.

This Palopinto soil is poorly suited to most urban and

Figure 17.—Fence-line contrast shows proper grazing and overgrazing on an area of Palopinto extrememly stony clay loam, 1 to 8 percent slopes.

recreation uses. Depth to rock and stoniness are the main limitations.

This soil is in capability subclass VIs and the Low Stony Hill range site.

34—Patilo fine sand, 1 to 3 percent slopes. This deep, moderately well drained, gently undulating soil is on uplands in the southeastern part of the county. Areas are irregular in shape and range from 5 to 300 acres.

Typically, the surface layer is medium acid, pale brown fine sand about 6 inches thick. From a depth of 6 to 45 inches is medium acid, light gray fine sand. The underlying layer to a depth of 65 inches is medium acid, strong brown sandy clay loam with light brownish gray mottles.

Permeability is moderately slow, and available water capacity is low. A perched water table is above the lower sandy clay loam layers for short periods following heavy rainfall. The hazard of soil blowing is severe because the sandy surface layer is single grain and loose when the soil is dry. The root zone is deep, but root penetration is limited because the sandy surface layer is not capable of storing much moisture. This soil responds well to fertilization.

Included with this soil in mapping are a few small areas of Chaney and Demona soils. These soils are on

small convex knolls. They are less than 5 acres and make up less than 20 percent of any mapped area.

This Patilo soil is mainly used as pastureland and is moderately well suited to this use. Bermudagrass and lovegrass are adapted to this soil. This soil is moderately well suited to use as cropland. Peanuts and sorghum are grown but suffer from lack of moisture, except during periods of favorable rainfall. Cover cropping and wind stripcropping help to control soil blowing. Leaving plant residue on the soil helps to conserve moisture, improve productivity, and control soil blowing.

This soil is moderately well suited to use as rangeland. The potential plant community is a post oak and blackjack oak savannah. The predominant plants are—

- indiangrass, big bluestem, and sand bluestem—15 percent
- sand lovegrass—10 percent
- forbs, such as trailing wildbean, lespedeza, eveningprimrose, bundleflower, and bullnettle—10 percent
- woody plants, such as post oak—15 percent
- blackjack oak—10 percent
- greenbrier—10 percent
- pricklyash—5 percent.

Other important plants are—

- sand dropseed—5 percent
- little bluestem—5 percent
- purpletop tridens—5 percent
- sand paspalum—5 percent
- Scribner panicum—5 percent.

Indiangrass, big bluestem, sand bluestem, and sand lovegrass are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. These plants are replaced by sand dropseed, fringeleaf paspalum, Scribner panicum, purpletop tridens, oaks, and other brush species. Continued overgrazing causes a decline of these plants, except for the oaks and other brush species. Thus, woody plants can eventually dominate this soil.

Potential for wildlife habitat is fair. Deer and turkeys are the main species. Where the brush is thick, however, the areas are mainly used as escape cover for deer.

Most areas are moderately well suited to urban uses. Wetness, moderately slow permeability of the lower layers, and the thick sandy surface layer are limitations.

This Patilo soil is poorly suited to recreation uses because of the thick, sandy upper layers.

This soil is in capability subclass IIIe and the Deep Sand range site.

35—Santo fine sandy loam, frequently flooded. This deep, well drained, nearly level and gently sloping soil is on flood plains. Slopes range from 0 to 3 percent. Flooding occurs about once every year; however, the soil is inundated for only a few hours each time. The long narrow flood plains range from 20 to 200 acres.

Typically, the surface layer is calcareous, light yellowish brown fine sandy loam about 8 inches thick. Below that is moderately alkaline, layered alluvial material. The upper part, from a depth of 8 to 12 inches, is brown loam. From a depth of 12 to 36 inches is pale brown fine sandy loam. The next layer, from a depth of 36 to 44 inches, is very pale brown loamy fine sand. At a depth of 44 to 70 inches is light yellowish brown fine sandy loam. In the lower part to a depth of 80 inches is brown fine sandy loam.

Permeability is moderately rapid, and available water capacity is medium. Flooding inundates this soil about once a year for a short period. The root zone is deep and is easily penetrated by plant roots. The hazard of soil blowing is moderate.

Included with this soil in mapping are small spots of closely similar soils that are not calcareous to the surface and other soils that are darker throughout. Some areas of occasionally flooded Santo soils on higher areas are included. These closely similar soils comprise 10 to 40 percent of each mapped area. Most of the areas are less than 20 acres. Also included in some areas are small strips of a soil that has a sandy surface layer. The soil is on foot slopes between the flood plain and adjoining uplands. Areas of this soil are 3 to 10 acres and make up less than 15 percent of any mapped area.

This Santo soil is dominantly used as pastureland and is well suited to this use. Bermudagrass and kleingrass are well adapted to the soil. Pecan trees are commonly managed in conjunction with pasture. This soil is poorly suited to use as cropland.

This soil is well suited to use as rangeland. The potential plant community is a tall grass savannah with a 10 to 15 percent canopy of woody plants. The predominant plants are—

- indiangrass—20 percent
- big bluestem—10 percent
- switchgrass—15 percent
- little bluestem—15 percent
- the rest is forbs, such as Maximilian sunflower, Engelmann-daisy, trailing wildbean, Baldwin ironweed, catclaw sensitivebrier, trailing ratany, heath aster, gaura, and dalea; and woody plants, such as American elm, pecan, live oak, hackberry, cottonwood, bumelia, and elbowbush.

Indiangrass, big bluestem, and switchgrass are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. They are replaced by sideoats grama, dropseed, Texas wintergrass, and woody plants. Continued overgrazing causes a decrease of these plants, except for woody plants that continue to increase along with an invasion of western ragweed, nightshade, common bermudagrass, and buffalograss.

Potential for wildlife habitat is fair. This area is inhabited by deer, turkeys, dove, and quail. Turkeys commonly use the large trees for roosting. Many of the choice forage plants for deer and turkeys are produced on this soil. Excellent resting and nesting places and escape cover are also provided.

This Santo soil is poorly suited to recreation and urban uses because of the hazard of flooding.

This soil is in capabilty subclass Vw and the Loamy Bottomland range site.

36—Set clay, 1 to 3 percent slopes. This deep, well drained, gently sloping soil is on knolls and foot slopes. Areas are irregular in shape and range from 15 to 100 acres.

Typically, the surface layer is moderately alkaline, dark grayish brown clay about 10 inches thick. From a depth of 10 to 42 inches is moderately alkaline clay that is pale brown in the upper part and light yellowish brown in the lower part. Below that to a depth of 50 inches is moderately alkaline, very pale brown shaly clay.

Permeability is slow, and available water capacity is high. Runoff is medium, and the hazard of water erosion is severe. The hazard of soil blowing is slight. The surface is very sticky and plastic when the soil is wet. This soil can be worked in a narrow range of moisture conditions. The root zone is deep, but the clayey layers restrict some root penetration. The lime content of this soil causes chlorosis, a yellowing of leaves, in some crops (fig. 18).

Included with this soil in mapping are small areas of Owens soils and a soil similar to the Set soil, except the surface is light colored. Also included in some low areas are small areas of Leeray soils. The Owens soils are on high knolls. These closely similar soils are in areas of less than 5 acres each and together make up less than 15 percent of any mapped area.

This Set soil is mainly used as rangeland and is well suited to this use. The potential plant community is a prairie of tall and mid grasses. The predominant plants are—

- big bluestem and switchgrass—15 percent
- little bluestem—25 percent
- indiangrass—10 percent
- sideoats grama—10 percent.

Other important plants are—

- cane bluestem and silver bluestem—5 percent
- vine-mesquite—5 percent
- Texas wintergrass—5 percent
- forbs, such as Engelmann-daisy, bundleflower, prairie-clover, Maximilian sunflower, sensitivebrier, and halfshrub sundrop, make up the rest.

Big bluestem, switchgrass, indiangrass, and many perennial forbs are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. These plants are replaced by little bluestem, sideoats grama, cane bluestem, silver bluestem, vine-mesquite, and Texas wintergrass. Continued overgrazing causes an invasion of threeawn, Texas grama, annual grasses and weeds, lotebush, pricklypear, tasajillo, juniper, and mesquite.

Potential for wildlife habitat is fair. This area is inhabited by deer, dove, and quail. Several of the forbs and grasses provide seed for game birds and animals. A good selection of forbs is available for deer forage, but little cover and protection is provided for escape and resting.

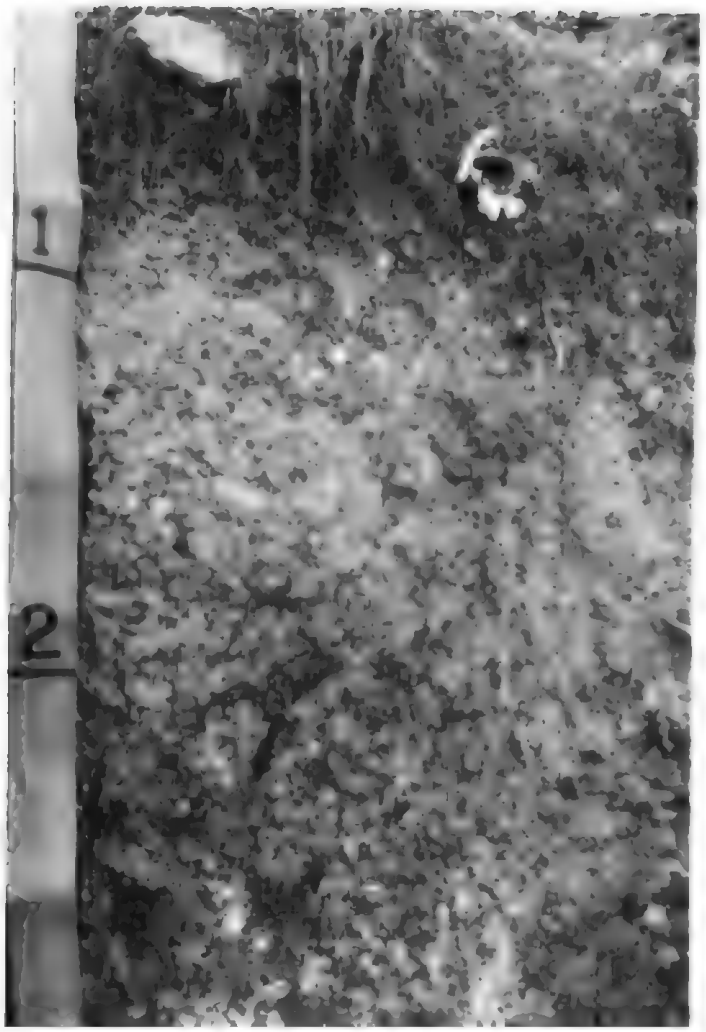


Figure 18.—Profile of Set clay, 1 to 3 percent slopes. Concretions and masses of calcium carbonate are visible at depths of 1 to 3 feet. Depths are shown in feet.

This soil is moderately well suited to use as cropland. Using terraces and contour farming help to control erosion. Leaving crop residue on the soil helps to conserve moisture, reduce runoff, and maintain productivity. This soil is moderately well suited to use as pastureland. Kleingrass and King Ranch bluestem are adapted to the soil.

This Set soil is poorly suited to most urban and recreation uses. Shrink-swell potential, slow permeability, and high clay content are limitations. Proper design and careful installation procedures are needed.

This soil is in capability subclass IIe and the Clay Loam range site.

37—Set clay, 3 to 5 percent slopes. This deep, well drained, gently sloping soil is on knolls and foot slopes. Areas are irregular in shape and range from 15 to 100 acres.

Typically, the surface layer is moderately alkaline, dark brown clay about 12 inches thick. From a depth of 12 to 50 inches is moderately alkaline clay that is pale brown in the upper part and light brownish gray in the lower part. Below that to a depth of 60 inches is moderately alkaline, pale olive shaly clay.

Permeability is slow, and available water capacity is high. The high lime content affects the availability of some nutrients for plants. Runoff is rapid, and the hazard of water erosion is severe. The hazard of soil blowing is slight. The surface is very sticky and plastic when the soil is wet. This soil can be easily worked in a narrow range of moisture conditions. The root zone is deep, but the clayey layers restrict some root penetration.

Included with this soil in mapping are small areas of Leeray and Owens soils. Leeray soils are mostly in low areas, and Owens soils are on upper slopes. Also included are some areas of sloping Set soils on foot slopes. These closely similar soils are in areas of less than 10 acres and together make up less than 30 percent of any mapped area.

This Set soil is mainly used as rangeland and is well suited to this use. The potential plant community is a prairie of tall and mid grasses. The predominant plants are—

- big bluestem and switchgrass—15 percent
- little bluestem—25 percent
- indiangrass—10 percent
- sideoats grama—10 percent.

Other important plants are—

- cane bluestem and silver bluestem—5 percent
- vine-mesquite—5 percent
- Texas wintergrass—5 percent
- forbs, such as Englemann-daisy, bundleflower, prairie-clover, Maximilian sunflower, sensitivebrier, and halfshrub sundrop, make up the rest.

Big bluestem, switchgrass, indiangrass, and many perennial forbs are preferred by livestock; therefore, they are grazed out of the community first if grazing is not controlled. These plants are replaced by an increase of little bluestem, sideoats grama, cane bluestem, silver bluestem, vine-mesquite, and Texas wintergrass. Continued overgrazing causes a decline of all these plants and an invasion of threeawn, Texas grama, annual grasses and weeds, lotebush, pricklypear, tasajillo, juniper, and mesquite.

Potential for wildlife habitat is fair. This area is inhabited by deer, dove, and quail. Several of the forbs and grasses provide seed for game birds and animals. A good selection of forbs is available for deer forage, but little cover and protection is provided for escape and resting.

This soil is moderately well suited to use as cropland. Major crops are small grain and grain sorghum. Using terraces and contour farming help to control erosion. Leaving crop residue on the soil helps to conserve moisture, reduce runoff, and maintain productivity. This soil is moderately well suited to use as pastureland. Kleingrass and King Ranch bluestem are adapted to the soil.

This Set soil is poorly suited to most urban and recreation uses. Shrink-swell potential, slow permeability, and high clay content are limitations that are difficult to overcome. Proper design and careful installation procedures, however, make most uses possible.

This soil is in capability subclass IIIe and the Clay Loam range site.

38—Set-Palopinto complex, extremely stony, 8 to 40 percent slopes. These deep, shallow, well drained, strongly sloping to steep soils are on extremely stony escarpments. Limestone fragments, 3 to 40 inches in diameter, cover 15 to 40 percent of the surface. Areas are long and narrow and range from 20 to 2,000 acres.

Set extremely stony clay makes up about 58 percent of the complex, Palopinto extremely stony clay loam about 27 percent, and other soils about 15 percent. The Palopinto soil is generally in narrow bands 20 to 75 feet wide and at 30- to 200-feet intervals in areas of the Set soil. Areas of these soils are so intricately mixed that it is not practical to map them separately.

The Set soil typically has a moderately alkaline, dark grayish brown extremely stony clay surface layer about 12 inches thick. About 20 percent of the surface is covered with limestone fragments that are 10 to 36 inches in diameter. From a depth of 12 to 26 inches is moderately alkaline, brown clay. At a depth of 26 to 38 inches is moderately alkaline, yellowish brown silty clay. From a depth of 38 to 44 inches is moderately alkaline, light yellowish brown silty clay loam. Below that to a depth of 60 inches is moderately alkaline, light brownish gray shaly clay.

Permeability of the Set soil is slow, and available water capacity is high. Runoff is rapid, and the hazard of water erosion is severe. The hazard of soil blowing is slight. The root zone is deep, but plant roots are somewhat restricted by the clayey layers.

The surface layer of Palopinto extremely stony clay loam typically is moderately alkaline, dark grayish brown and about 12 inches thick. It is 40 to 70 percent limestone fragments. About 30 percent of the surface is covered with limestone fragments that are 3 to 40 inches in diameter. Below that is fractured limestone bedrock.

The Palopinto soil is well drained. Permeability is moderate, and available water capacity is very low. Surface runoff is rapid. The root zone is shallow.

Included with these soils in mapping, and making up 10 to 20 percent of some mapped areas, are small areas of vertical limestone cliffs and large boulders on the upper edge of the escarpment. Also included are small areas of non-stony Set soils and Leeray and Lindy soils that are less than 5 acres. These soils comprise 5 to 10

percent of most mapped areas. Included soils and miscellaneous areas average about 15 percent of any mapped area.

The soils in this complex are mainly used as rangeland and for wildlife habitat. They are moderately well suited to use as rangeland. The potential plant community on the Set soil is a prairie of tall and mid grasses. The predominant plants are—

- big bluestem and switchgrass—15 percent
- little bluestem—25 percent
- indiangrass—10 percent
- sideoats grama—10 percent.

Other important plants are—

- cane bluestem and silver bluestem—5 percent
- vine-mesquite—5 percent
- Texas wintergrass—5 percent
- forbs, such as Engelmann-daisy, bundleflower, prairie-clover, Maximilian sunflower, sensitivebrier, and halfshrub sundrop, make up the rest.

Big bluestem, switchgrass, indiangrass, and many perennial forbs are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. These plants are replaced by little bluestem, sideoats grama, cane bluestem, silver bluestem, vine-mesquite, and Texas wintergrass. Continued overgrazing causes a decline of these plants and an invasion of threeawn, Texas grama, annual grasses and weeds, lotebush, pricklypear, tasajillo, juniper, and mesquite.

The potential plant community on the Palopinto soil is a tall and mid grass, live oak savannah. The predominant plants are—

- little bluestem—30 percent
- indiangrass and big bluestem—5 percent
- sideoats grama, tall dropseed, silver bluestem, cane bluestem, and vine-mesquite—5 percent
- Texas wintergrass, Canada wildrye, and Virginia wildrye—10 percent
- forbs, such as Maximilian sunflower, bushsunflower, dotted gayfeather, bundleflower, sensitivebrier, yellow neptunia, dalea, prairie-clover, and scurfpea—5 percent
- live oak, cedar elm, Texas oak, and hackberry—10 percent
- Texas cupgrass, plains lovegrass, threeawn, buffalograss, sumac, bumelia, elbowbush, shin oak, and greenbrier make up the rest.

Big bluestem, indiangrass, little bluestem, Canada wildrye, and palatable forbs are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. These plants are replaced by sideoats grama, silver bluestem, cane bluestem, Texas wintergrass, and buffalograss. Continued overgrazing causes buffalograss and Texas wintergrass to persist, but with low vigor. The site will be invaded by hairy tridens, Texas grama, tumblegrass, red threeawn, Ashe juniper, agarito, mesquite, pricklypear, tasajillo, prairie coneflower, silverleaf nightshade, and other annual grasses and forbs.

The soils in this complex have fair potential for wildlife habitat. Deer, dove, quail, and turkeys inhabit this area. Cover is adequate. Browse plants, forbs, and grasses that grow on the site furnish a year-round food supply.

These soils are poorly suited to use as cropland or pastureland and poorly suited to recreation and urban uses. Stoniness, strong to steep slopes, and shallow soil depth are the main limitations.

This complex is in capability subclass VIIs. The Set part is in the Clay Loam Slope range site, and the Palopinto part is in the Steep Rocky range site.

39—Shatruce very bouldery sandy loam, 8 to 40 percent slopes. This moderately deep, well drained, strongly sloping to steep soil is on very bouldery escarpments (fig. 19). Sandstone boulders and fragments cover 15 to 50 percent of the surface. They range from 6 inches to as much as 25 feet in diameter. Areas are long and narrow and range from 30 to 1,000 acres or more.

Typically, the surface layer is neutral, dark grayish brown very bouldery sandy loam about 2 inches thick. From a depth of 2 to 14 inches is slightly acid, very pale brown sandy loam. At a depth of 14 to 34 inches is very strongly acid clay that is red in the upper part, yellowish red in the middle part, and reddish yellow in the lower part. The underlying layer from a depth of 34 to 60 inches is strongly acid, grayish brown shaly clay.

Permeability of the Shatruce soil is slow. Available water capacity is medium, and runoff is rapid. The hazard of soil blowing is slight. The hazard of water erosion is severe. The root zone is moderately deep, but the dense, clayey lower layers restrict some root penetration.

Included with this soil in mapping are small areas of very bouldery Bonti, Exray, Owens, and Truce soils. These closely similar soils are 5 to 20 acres and comprise 20 to 40 percent of most areas. Rock outcrops are on the upper edges of escarpments. These outcrops consist of vertical, discontinuous sandstone cliffs and ledges that are long and narrow, 30 to 100 feet wide, and 1/2 mile to 5 miles long. The rock outcrops make up 15 to 20 percent of most mapped areas.

This Shatruce soil is used as rangeland and is moderately well suited to this use. Forage production is low. The potential plant community is a mid grass, post oak savannah. The predominant plants are—

- little bluestem—20 percent
- sideoats grama—20 percent
- Arizona cottontop—10 percent
- silver bluestem—10 percent
- indiangrass—5 percent
- sand lovegrass—5 percent
- forbs, such as prairie-clover, bundleflower, and lespedeza; and woody plants, such as post oak and skunkbush sumac, make up the rest.

Little bluestem, indiangrass, and sand lovegrass are preferred by livestock; therefore, they are grazed out first

Figure 19.—Area of Shatruce very bouldery sandy loam, 8 to 40 percent slopes, in the Bouldery Hills range site.

if grazing is not controlled. These plants are replaced by sideoats grama, silver bluestem, Arizona cottontop, dropseed, hooded windmillgrass, skunkbush sumac, and post oak. Continued overgrazing, however, causes a decline of many of these plants and an invasion of threeawn, low panicum, red lovegrass, weedy forbs, and mesquite. Post oak continues to increase along with Texas ash, elm, juniper, and skunkbush sumac.

Potential for wildlife habitat is good. This area provides habitat for deer and good nesting areas for doves and songbirds. The rough terrain is attractive to fur-bearing animals. This area probably has greater value for wildlife habitat than for cattle production. Cattle graze this site very little because of the slopes and low forage production.

This Shatruce soil is poorly suited to use as cropland or pastureland and poorly suited to recreation and urban uses. Strong to steep slopes and boulders are the main limitations.

This soil is in capability subclass VIIIs and the Bouldery Hills range site.

40—Shavash stony loamy fine sand, 1 to 3 percent slopes. This shallow, well drained, gently sloping soil is on stony upland ridges. Sandstone fragments, 10 to 36 inches in diameter, cover about 3 percent of the surface. Areas are irregular in shape and range from 20 to 200 acres.

Typically, the surface layer is slightly acid, brownish stony loamy fine sand about 10 inches thick. From a depth of 10 to 16 inches is slightly acid, brownish yellow,

mottled sandy clay loam. Below that is strongly cemented sandstone.

Permeability is moderate, and available water capacity is very low. Surface runoff is slow. The surface layer is crusty and becomes hard and massive when the soil is dry. The hazard of soil blowing is slight. The hazard of water erosion is severe. The root zone is shallow over sandstone.

Included with this soil in mapping are small areas of stony Bonti and Vashti soils. These closely similar soils are in areas of 2 to 15 acres and make up 10 to 30 percent of most areas. A few spots of very stony Shavash soils that are less than 3 acres are also included.

This Shavash soil is used as rangeland and is moderately well suited to this use. The potential plant community is a post oak savannah with an understory of tall and mid grasses. The predominant plants are—

- little bluestem—30 percent
- big bluestem and indiangrass—15 percent
- sand lovegrass—10 percent
- forbs, such as trailing wildbean, partridge pea, dayflower, dalea, catclaw sensitivebrier, dotted gayfeather, senna, croton, and western ragweed—5 percent
- woody plants, such as post oak—15 percent
- greenbrier, bumelia, pricklyash, blackjack oak, western soapberry, plums, grapes, and sumac—5 percent.

Other important plants are sand dropseed, tall dropseed, purpletop tridens, silver bluestem, and Texas bluegrass.

Big bluestem, indiangrass, sand lovegrass, and palatable forbs are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. They are replaced by silver bluestem, tall dropseed, Texas wintergrass, and woody plants. Continued overgrazing causes a decline of these plants, except for post oak and woody plants which continue to increase along with an invasion of fall witchgrass; hooded windmillgrass; red, tumble, and gummy lovegrasses; tumblegrass; threeawn; mesquite; juniper; and catclaw. The plant community can degenerate to a thick stand of trees and brush.

Potential for wildlife habitat is fair. Deer, turkeys, squirrels, quail, and dove inhabit this area. They feed extensively on acorns and other mast. Other small animals and birds feed and raise their young on this site. Birds also nest here. If brush is dense, habitat for most wildlife species declines, although deer use the brush for escape and resting cover.

This Shavash soil is poorly suited to use as cropland and pastureland and is poorly suited to urban uses. Shallow soil depth and large stones on the surface are the main limitations. The soil is also poorly suited to most recreation uses.

This soil is in capability subclass VIs and the Loamy Sand range site.

41—Thurber clay loam, 0 to 1 percent slopes. This deep, moderately well drained, nearly level soil is on broad upland valleys. Areas are irregular to oval in shape and range from 5 to 150 acres.

Typically, the surface layer is brown clay loam about 6 inches thick. From a depth of 6 to 45 inches is clay that is dark grayish brown in the upper part and light brownish gray in the lower part. At a depth of 45 to 60 inches is very pale brown clay loam that has many soft masses of calcium carbonate. Reaction is neutral in the upper part of this soil and moderately alkaline in the lower part.

Permeability is very slow, and available water capacity is high. Tilth is poor. The surface layer is very hard and massive when the soil is dry. Runoff is slow. The hazards of water erosion and soil blowing are slight. This soil can be worked easily in a very narrow range of moisture content. The root zone is deep, but root penetration is restricted by the dense, clayey lower layers.

Included with this soil in mapping are small areas of Hassee and Leeray soils. Hassee soils are as much as 5 acres and are occasionally ponded. Leeray soils are in positions similar to the Thurber soil but have deep cracks when dry. The included soils are less than 10 acres and together make up about 10 percent of most mapped areas.

This Thurber soil is dominantly used as rangeland and is moderately well suited to this use. The potential plant community is a mid and short grass prairie. The predominant plants are—

- sideoats grama—20 percent
- vine-mesquite—20 percent
- Arizona cottontop—10 percent
- forbs, such as sagewort, heath aster, verbena, greenthread, and Maximilian sunflower—5 percent
- woody plants, such as lotebush and mesquite—5 percent
- blue grama, silver bluestem, Texas wintergrass, tall dropseed, buffalograss, curlymesquite, and white tridens make up the rest.

Sideoats grama, vine-mesquite, blue grama, Arizona cottontop, and the perennial forbs are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. These plants are replaced by an increase of silver bluestem, buffalograss, Texas wintergrass, tall dropseed, and perennial threeawn. Continued overgrazing causes a decline in most of these plants and a continued increase of lotebush along with an invasion of mesquite, pricklypear, tasajillo, annual lovegrasses, hairy tridens, and tumble lovegrass.

Potential for wildlife habitat is fair. This area is inhabited by dove, quail, rabbits, and deer. Ample food for birds is produced. Deer use this area for supplemental grazing along major drainageways, where adjacent protective cover is abundant.

This soil is moderately well suited to use as cropland. Small grain and grain and forage sorghums are grown.

Returning crop residue to the soil is necessary to conserve moisture and to improve tilth (fig. 20). This soil is moderately well suited to use as pastureland. King Ranch bluestem is well adapted to the soil.

This Thurber soil is poorly suited to most urban and recreation uses. Shrink-swell potential, very slow permeability, and the clayey texture are limitations. These limitations generally can be overcome by proper design.

This soil is in capability subclass IIIs and the Claypan Prairie range site.

42—Thurber clay loam, 1 to 3 percent slopes. This deep, moderately well drained, gently sloping soil is on broad upland valleys. Areas are irregular in shape and range from 15 to 150 acres. They average about 40 acres.

Typically, the surface layer is mildly alkaline, grayish brown clay loam about 8 inches thick. From a depth of 8 to 26 inches is mildly alkaline, very dark grayish brown clay. At a depth of 26 to 36 inches is moderately alkaline, dark grayish brown clay. Below that to a depth of 72 inches is moderately alkaline, light brownish gray clay with common masses of calcium carbonate.

Permeability is very slow, and available water capacity is high. Tilth is poor. The surface layer is very hard and massive when the soil is dry. Runoff is rapid, and the hazard of water erosion is severe. The hazard of soil blowing is slight. This soil can be worked easily in a narrow range of moisture conditions. The root zone is deep, but plant roots are somewhat restricted by the dense lower layers of clay.

Included with this soil in mapping are small areas of Hassee and Leeray soils. Hassee soils are in low areas that are occasionally ponded. Leeray soils are in positions similar to the Thurber soil. These included soils

Figure 20.—Seedbed preparation in an area of Thurber clay loam, 0 to 1 percent slopes.

are less than 15 acres and together make up less than 15 percent of any mapped area.

This Thurber soil is mainly used as rangeland and is moderately well suited to this use. The potential plant community is a mid and short grass prairie. The predominant plants are—

- sideoats grama—20 percent
- vine-mesquite—20 percent
- Arizona cottontop—10 percent
- forbs, such as sagewort, heath aster, verbena, greenthread, and Maximilian sunflower—5 percent
- woody plants, such as lotebush and mesquite—5 percent
- blue grama, silver bluestem, Texas wintergrass, tall dropseed, buffalograss, curlymesquite, and white tridens make up the rest.

Sideoats grama, vine-mesquite, blue grama, Arizona cottontop, and the perennial forbs are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. These plants are replaced by silver bluestem, buffalograss, Texas wintergrass, tall dropseed, and perennial threeawn. Continued overgrazing causes a decline in most of these plants and an increase of lotebush along with mesquite trees, pricklypear, tasajillo, annual lovegrasses, hairy tridens, and tumble lovegrass.

Potential for wildlife habitat is fair. This area is inhabited by dove, quail, rabbits, and deer. Ample food for birds is produced. Deer use this area for supplemental grazing along major drainageways, where adjacent protective cover is abundant.

This soil is moderately well suited to use as cropland. Small grain and forage sorghum are grown in some areas. Using terraces, contour cultivating, and leaving crop residue on the soil help to control erosion and maintain productivity and tilth. This soil is moderately well suited to use as pastureland. King Ranch bluestem is adapted to the soil.

This Thurber soil is poorly suited to most urban and recreation uses. Shrink-swell potential and very slow permeability are limitations that are difficult to overcome.

This soil is in capability subclass IIIe and the Claypan Prairie range site.

43—Truce fine sandy loam, 1 to 3 percent slopes. This deep, well drained, gently sloping soil is on convex uplands. Areas are irregular in shape and range from 15 to 100 acres.

Typically, the surface layer is slightly acid fine sandy loam about 7 inches thick. The upper 6 inches is brown, and the lower 1 inch is pink. From a depth of 7 to 48 inches is neutral clay that is yellowish red in the upper part, brown in the middle part, and brownish yellow in the lower part. The underlying layer from a depth 48 to 60 inches is moderately alkaline, pale yellow shaly clay interbedded with olive shaly clay and thin soft sandstone strata.

Permeability is slow, and available water capacity is low. The surface layer is very hard and massive when the soil is dry. The tendency of the surface to crust and the convex slopes cause a rapid runoff rate. The hazard of water erosion is severe. The dense, clayey lower layers restrict water intake, making this soil droughty. The hazard of soil blowing is moderate. The soil can be easily worked in a narrow range of moisture conditions. The root zone is deep, but plant roots are severely restricted by the clayey lower layers.

Included with this soil in some mapped areas are small areas of Bonti, Hassee, Owens, and Thurber soils. Bonti soils are on ridgetops that have plane surfaces. Owens soils are on convex knolls. Hassee and Thurber soils are on lower slopes and in slight depressions. Rock outcrops are included in some areas. Also included in some areas is a soil similar to this Truce soil, except that the underlying shale is at a shallower depth. The included soils are less than 10 acres and together make up less than 20 percent of any mapped area.

This Truce soil is dominantly used as rangeland. It is moderately well suited to this use. The potential plant community is a mid grass, post oak savannah. The predominant plants are—

- sideoats grama—30 percent
- vine-mesquite—15 percent
- Arizona cottontop—10 percent
- little bluestem, blue grama, silver bluestem, buffalograss, and Texas wintergrass—5 percent each
- post oak—10 percent
- hooded windmillgrass and perennial threeawn—5 percent.

Forbs, such as western ragweed, heath aster, sagewort, sensitivebrier, and primrose and a small amount of cedar elm, pricklyash, skunkbush sumac, lotebush, and agarito make up the rest of this plant community.

Sideoats grama, Arizona cottontop, and vine-mesquite are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. These plants are replaced by buffalograss, hooded windmillgrass, Texas wintergrass, and post oak. Continued overgrazing causes a decline in all of these plants, except buffalograss and post oak which increase along with an invasion of hairy tridens, Texas grama, mesquite, juniper, pricklypear, and tasajillo.

Potential for wildlife habitat is good. Quail and dove inhabit this area. Deer and turkeys feed in this area and use cover on adjacent soils.

This soil is moderately well suited to use as cropland. Using terraces and contour cultivating help to control erosion. Residue from crops, such as small grain and forage sorghums, helps to control runoff, maintain tilth, and increase productivity. This soil is moderately well suited to use as pastureland. Kleingrass and King Ranch bluestem are adapted to this soil.

This Truce soil is poorly suited to most urban uses. The shrink-swell potential and dense, clayey lower layers are limitations that can be overcome by using proper

design and proper installation procedures. This soil is moderately well suited to recreation uses.

This soil is in capability subclass IIe and the Tight Sandy Loam range site.

44—Truce fine sandy loam, 3 to 5 percent slopes. This deep, well drained, gently sloping soil is on convex uplands. Areas are irregular in shape and range from 15 to 100 acres.

Typically, the surface layer is slightly acid, pale brown fine sandy loam about 8 inches thick. From a depth of 8 to 25 inches is neutral, reddish brown clay. At a depth of 25 to 45 inches is neutral, brownish yellow clay. The underlying layer to a depth of 60 inches is moderately alkaline, pale olive gray shaly clay.

Permeability is slow, and available water capacity is low. The surface layer is very hard and massive when the soil is dry. These factors, in combination with the convex slopes, cause rapid runoff during rainy periods of short duration. The hazard of water erosion is severe, and the hazard of soil blowing is moderate. This soil is droughty. It can be easily worked in a narrow range of moisture conditions. The root zone is deep, but plant roots are severely restricted by the clayey lower layers.

Included with this soil in mapping are small areas of Bonti, Hassee, Owens, and Thurber soils. The Bonti soils are on plane surfaces. Hassee soils are in small depressions. Owens soils are on knolls. Thurber soils are on low-lying flats. These included soils are 2 to 5 acres and together make up 5 to 15 percent of most mapped areas.

This Truce soil is dominantly used as rangeland and is moderately well suited to this use. The potential plant community is a mid grass, post oak savannah. The predominant plants are—

- sideoats grama—30 percent
- vine-mesquite—15 percent
- Arizona cottontop—10 percent
- little bluestem, blue grama, silver bluestem, buffalograss, and Texas wintergrass—5 percent each
- post oak—10 percent
- hooded windmillgrass and perennial threeawn—5 percent.

Forbs, such as western ragweed, heath aster, sagewort, sensitivebrier, and primrose and a small amount of cedar elm, pricklyash, skunkbush sumac, lotebush, and agarito make up the rest of this plant community.

Sideoats grama, Arizona cottontop, and vine-mesquite are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. These plants are replaced by buffalograss, hooded windmillgrass, Texas wintergrass, and post oak. Continued overgrazing causes a decline in all of these plants, except buffalograss and post oak which increase along with an invasion of hairy tridens, Texas grama, mesquite, juniper, pricklypear, and tasajillo.

Potential for wildlife habitat is good. Quail and dove inhabit this area. Deer and turkeys feed in this area and use the cover on adjacent soils.

This soil is moderately well suited to use as cropland. Forage sorghum is adapted to this soil. Using terraces and contour cultivating help to control erosion. Crop residue helps to control runoff and maintain tilth and productivity. This soil is moderately well suited to use as pastureland. Kleingrass and King Ranch bluestem are adapted to this soil.

This soil is poorly suited to most urban uses. Shrink-swell potential and slow permeability are limitations that can be overcome by using proper design and careful installation procedures. The soil is moderately well suited to recreation uses.

This soil is in capability subclass IIIe and the Tight Sandy Loam range site.

45—Truce fine sandy loam, 1 to 5 percent slopes, eroded. This deep, well drained, gently sloping soil is on convex uplands. Areas are irregular in shape and range from 15 to 60 acres. Water erosion has removed 25 to 75 percent of the original surface layer in most areas. The original surface layer was probably about 8 inches thick. In some areas there are gullies that are 50 to 300 feet apart. These gullies are 1 to 3 feet wide, 30 to 100 feet long, and 1 to 3 feet deep. Most of them can be crossed by farm machinery.

Typically, the surface layer is neutral, yellowish brown fine sandy loam about 3 inches thick. From a depth of 3 to 44 inches is neutral clay that is reddish brown in the upper part, brown in the middle part, and yellowish brown in the lower part. Below that to a depth of 60 inches is moderately alkaline, pale olive shaly clay.

Permeability is slow, and available water capacity is low. The surface layer is very hard and massive when the soil is dry. Because much of the original surface layer has been lost by erosion, the present plow layer is low in organic matter content and plant nutrients. Runoff is rapid, and the hazard of water erosion is severe. The hazard of soil blowing is moderate. This soil can be easily worked in a narrow range of moisture conditions. The root zone is deep, but plant roots are severely restricted by the dense, clayey lower layers.

Included with this soil in mapping are small areas of Bonti and Owens soils. The Bonti soils are on the upper plane surfaces. The Owens soils are on the upper convex knolls. These included soils are less than 10 acres and together make up less than 15 percent of any mapped area.

This Truce soil is dominantly used as rangeland and is moderately well suited to this use. The potential plant community is a mid grass, post oak savannah. The predominant plants are—

- sideoats grama—30 percent
- vine-mesquite—15 percent
- Arizona cottontop—10 percent

- little bluestem, blue grama, silver bluestem, buffalograss, and Texas wintergrass—5 percent each
- post oak—10 percent
- hooded windmillgrass and perennial threeawn—5 percent.

Forbs, such as western ragweed, heath aster, sagewort, sensitivebrier, and primrose, and a small amount of cedar elm, pricklyash, skunkbush sumac, lotebush, and agarito make up the rest of this plant community.

Sideoats grama, Arizona cottontop, and vine-mesquite are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. These plants are replaced by buffalograss, hooded windmillgrass, Texas wintergrass, and post oak. Continued overgrazing causes a decline in all of these plants, except buffalograss and post oak which increase along with an invasion of hairy tridens, Texas grama, mesquite, juniper, pricklypear, and tasajillo.

Potential for wildlife habitat is good. Quail and dove inhabit areas of this soil. Deer and turkeys feed in the areas and use the cover on adjacent soils.

This soil is poorly suited to use as cropland. Forage sorghum is the main crop. Using terraces and contour cultivating help to control erosion. Leaving crop residue on the soil helps to control runoff, maintain tilth, and improve productivity. This soil is moderately well suited to use as pastureland. Kleingrass and King Ranch bluestem are adapted to this soil.

This Truce soil is poorly suited to most urban and recreation uses. Limitations that can be overcome by using proper design and careful installation procedures are high shrink-swell potential and slow permeability.

This soil is in capability subclass IIIe and the Tight Sandy Loam range site.

46—Truce-Bonti complex, extremely stony, 8 to 40 percent slopes. These deep and moderately deep, well drained, strongly sloping to steep soils are on hillsides (fig. 21). Sandstone fragments, 6 to 36 inches in diameter, cover 15 to 40 percent of the surface. Areas are long and narrow and range from 30 to 1,000 acres.

The Truce soil makes up about 60 percent of the complex, Bonti soil about 23 percent, and other soils about 17 percent. Areas of these soils are so intricately mixed that it is not practical to map them separately.

The Truce soil typically has a neutral, yellowish brown extremely stony fine sandy loam surface layer about 4 inches thick. From a depth of 4 to 6 inches is neutral, light yellowish brown fine sandy loam. At a depth of 6 to 44 inches is neutral clay that is yellowish red in the upper part, brown in the middle part, and light olive brown in the lower part. Below that to a depth of 60 inches is mildly alkaline, olive shaly clay.

Permeability of the Truce soil is slow, and available water capacity is low. Surface runoff is rapid, and the hazard of water erosion is severe. The hazard of soil blowing is slight. The root zone is deep, but the dense, clayey lower layers restrict some root penetration.

Typically, the Bonti soil has a brownish, extremely stony fine sandy loam surface layer about 5 inches thick. From a depth of 5 to 26 inches is red clay that is medium acid in the upper part and strongly acid in the lower part. Below that is sandstone bedrock.

Permeability of the Bonti soil is moderately slow, and available water capacity is low. Surface runoff is rapid, and the hazard of water erosion is severe. The hazard of soil blowing is slight. The root zone is moderately deep, but the clayey lower layers restrict some root penetration.

Included with these soils in mapping are small spots of Exray, Owens, and Shatruce soils. In most places these soils are in narrow bands around the hills. Areas of these soils are 5 to 40 acres and make up 17 percent of most mapped areas.

The soils in this complex are used as rangeland and are moderately well suited to this use. The potential plant community is a post oak savannah with an understory of tall and mid grasses. The predominant plants are—

- little bluestem—30 percent
- indiangrass—15 percent
- sideoats grama—10 percent
- western ragweed, bundleflower, prairie-clover, lespedeza, and sagewort—5 percent
- post oak—15 percent
- big bluestem, switchgrass, sand lovegrass, Scribner panicum, Texas ash, skunkbush sumac, honeysuckle, elbowbush, catclaw, and lotebush make up the rest.

Big bluestem, indiangrass, switchgrass, and sand lovegrass are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. These plants are generally replaced by little bluestem. If little bluestem is grazed out, silver bluestem, hairy grama, and skunkbush sumac replace it. Continued overgrazing causes a decline in all of these plants, except skunkbush sumac which continues to increase along with an invasion of threeawn, red lovegrass, annual grasses and forbs, mesquite, and juniper. Post oak and elm also increase.

These soils provide good cover for deer, quail, dove, and turkeys. The absence of quality winter plants for deer is a limitation for wildlife habitat.

Figure 21.—Mouflon sheep in an area of Truce-Bonti complex, extremely stony, 8 to 40 percent slopes. Many areas are managed for wildlife habitat and rangeland.

These soils are poorly suited to use as cropland and pastureland and are poorly suited to recreation and urban uses. Slopes and stones are limitations that restrict the use of this soil (fig. 22).

The soils in this complex are in capability subclass VIIs and the Sandstone Hill range site.

47—Vashti loamy fine sand, 1 to 5 percent slopes. This moderately deep, moderately well drained, gently sloping soil is on ridges. Areas are irregular in shape and range from 30 to 300 acres.

Typically, the surface layer is slightly acid, brownish loamy fine sand about 16 inches thick. From a depth of 16 to 34 inches is slightly acid sandy clay loam that is yellowish brown in the upper part and brownish yellow in the lower part. It has brownish and reddish mottles throughout. Below that, at a depth of 34 inches, is reddish yellow sandstone bedrock.

Permeability is moderate, and available water capacity is medium. A perched water table is above the sandstone for short periods following heavy rainfall. The surface is crusty and hard when the soil is dry. The hazards of soil blowing and water erosion are severe. The root zone is moderately deep and easily penetrated by plant roots.

Included with this soil in mapping, and making up 10 to 20 percent of the unit, are small areas of Bonti and Shavash soils.

This Vashti soil is dominantly used as rangeland and is well suited to this use. The potential plant community is a post oak savannah with an understory of tall and mid grasses. The predominant plants are—

- little bluestem—30 percent
- big bluestem and indiangrass—15 percent
- sand lovegrass—10 percent
- forbs, such as trailing wildbean, partridge pea, dayflower, dalea, catclaw sensitivebrier, dotted gayfeather, senna, croton, and western ragweed—5 percent
- woody plants, such as post oak—15 percent
- greenbrier, bumelia, pricklyash, blackjack oak, western soapberry, plums, grapes, and sumac—5 percent.

Other important plants are sand dropseed, tall dropseed, purpletop tridens, silver bluestem, and Texas bluegrass.

Big bluestem, indiangrass, sand lovegrass, and palatable forbs are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. They are replaced by silver bluestem, tall dropseed, Texas wintergrass, and woody plants. Continued overgrazing causes a decline of these plants, except for post oak and woody plants which continue to increase along with an invasion of fall witchgrass; hooded windmillgrass; red, tumble, and gummy lovegrasses; tumblegrass; threeawn; mesquite; juniper; and catclaw. The plant community can degenerate to a thick stand of trees and brush.

Potential for wildlife habitat is good. This area is inhabited by deer, turkeys, squirrels, quail, and dove that feed extensively on acorns and other mast. Other small animals and birds feed and raise their young on this site. If brush is dense, habitat for most wildlife species declines, although deer use the brush for escape and resting cover.

This soil is well suited to use as cropland. Peanuts and forage sorghum are adapted to the soil. Leaving crop residue on the soil helps to control runoff and maintain tilth and productivity. Stripcropping and using cover crops help to control soil blowing if peanuts are grown. This soil is well suited to use as pastureland. Bermudagrass, kleingrass, and lovegrass are well suited to this soil.

This Vashti soil is moderately well suited to most urban and recreation uses. The depth to rock is a severe limitation for septic tank filter fields. The shrink-swell potential is a limitation for buildings, dwellings, and roads. These limitations can be overcome with proper design. The sandy surface layer is a limitation for recreation uses.

This soil is in capability subclass IIIe and the Loamy Sand range site.

48—Velow clay loam, 1 to 3 percent slopes. This deep, well drained, gently sloping soil is on foot slopes and in shallow valleys. Areas are irregular in shape and range from 20 to 100 acres.

Typically, the surface layer is moderately alkaline, dark grayish brown clay loam about 10 inches thick. From a depth of 10 to 60 inches is moderately alkaline, brown clay loam.

Permeability is moderate, and available water capacity is high. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is slight. Tilth is fair, and the soil can be worked throughout a wide range of moisture conditions. The root zone is deep and easily penetrated by plant roots.

Included with this soil in mapping are small areas of Set soils and a soil similar to this Velow soil, except that it is calcareous to the surface and has a higher content of carbonates throughout. These included soils are in areas that are as much as 20 acres and together make up less than 20 percent of any mapped area.

Figure 22.—View from one ridgetop of Truce-Bonti complex, extremely stony, 8 to 40 percent slopes, to another ridgetop in the background. In the valley are Leeray and Thurber soils.

This Velow soil is mainly used as rangeland and is well suited to this use. The potential plant community is a prairie of tall and mid grasses. The predominant plants are—

- big bluestem and switchgrass—15 percent
- little bluestem—25 percent
- indiangrass—10 percent
- sideoats grama—10 percent.

Other important plants are—

- cane bluestem and silver bluestem—5 percent
- vine-mesquite—5 percent
- Texas wintergrass—5 percent
- forbs, such as Engelmann-daisy, bundleflower, prairie-clover, Maximilian sunflower, sensitivebrier, and halfshrub sundrop, make up the rest.

Big bluestem, switchgrass, indiangrass, and many perennial forbs are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. These plants are replaced by little bluestem, sideoats grama, cane and silver bluestem, vine-mesquite, and Texas wintergrass. Continued overgrazing causes an invasion of threeawn, Texas grama, annual grasses and weeds, lotebush, pricklypear, tasajillo, juniper, and mesquite.

Potential for wildlife habitat is fair. This area is inhabited by deer, dove, and quail. Several forbs and grasses provide seed for game birds and animals. A good selection of forbs for deer forage is available, but little cover and protection for escape and resting are provided.

This soil is well suited to use as cropland. Small grain, grain sorghum, and forage sorghum are grown in a few areas. Using terraces, contour farming, and leaving crop residue on the soil help to control erosion and maintain productivity and tilth. This soil is moderately well suited to use as pastureland. Kleingrass is adapted to the soil.

This Velow soil is well suited to most urban uses. It is moderately well suited to recreation uses. Slope is a moderate limitation in some places.

This soil is in capability subclass IIe and the Clay Loam range site.

49—Velow clay loam, 3 to 5 percent slopes. This deep, well drained, gently sloping soil is on foot slopes and in shallow valleys. Areas are irregular in shape and range from 30 to 100 acres.

Typically, the surface layer is mildly alkaline, dark grayish brown clay loam about 16 inches thick. From a depth of 16 to 60 inches is moderately alkaline, yellowish brown clay loam.

Permeability is moderate, and available water capacity is high. Runoff is rapid, and the hazard of water erosion is severe. The hazard of soil blowing is slight. Tilth is fair, and the soil can be worked well throughout a wide range of moisture conditions. The root zone is deep and easily penetrated by plant roots.

Included with this soil in mapping are small areas of Set soils and a soil closely similar to the Velow soil, except that it is calcareous to the surface and has a higher content of carbonates throughout. This similar soil is 10 to 20 acres and makes up 10 to 40 percent of some mapped areas. Set soils are 5 to 10 acres and make up 10 to 15 percent of some mapped areas.

This Velow soil is mainly used as rangeland and is well suited to this use. The potential plant community is a prairie of tall and mid grasses. The predominant plants are—

- big bluestem and switchgrass—15 percent
- little bluestem—25 percent
- indiangrass—10 percent
- sideoats grama—10 percent.

Other important plants are—

- cane bluestem and silver bluestem—5 percent
- vine-mesquite—5 percent
- Texas wintergrass—5 percent
- forbs, such as Engelmann-daisy, bundleflower, prairie-clover, Maximilian sunflower, sensitivebrier, and halfshrub sundrop, make up the rest.

Big bluestem, switchgrass, indiangrass, and many perennial forbs are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. These plants are replaced by little bluestem, sideoats grama, cane bluestem, silver bluestem, vine-mesquite, and Texas wintergrass. Continued overgrazing causes an invasion of threeawn, Texas grama, annual grasses and weeds, lotebush, pricklypear, tasajillo, juniper, and mesquite.

Potential for wildlife habitat is fair. This area is inhabited by deer, dove, and quail. Several of the forbs and grasses provide seed for game birds and animals. A good selection of forbs for deer forage is available, but little cover and protection for escape and resting are provided.

This soil is moderately well suited to use as cropland. Small grain, grain sorghum, and forage sorghum are grown in a few areas. Using terraces, contour farming, and leaving crop residue on the soil help to control erosion and maintain productivity and tilth. This soil is well suited to use as pastureland. Kleingrass is adapted to this soil.

This Velow soil is well suited to most urban uses. It is moderately well suited to recreation uses. Slope is a limitation in some areas.

This soil is in capability subclass IIIe and the Clay Loam range site.

50—Wichita clay loam, 1 to 3 percent slopes. This deep, well drained, gently sloping soil is on uplands. Areas are in broad valleys and on ancient terrace positions. Surfaces are plane to slightly convex. Areas range from 15 to 200 acres.

Typically, the surface layer is neutral, reddish brown clay loam about 8 inches thick. From a depth of 8 to 25 inches is neutral, red clay. At a depth of 25 to 35 inches is moderately alkaline, yellowish red clay loam. Below that to a depth of 60 inches is moderately alkaline, brownish yellow clay loam.

Permeability is moderately slow, and available water capacity is high. Runoff is medium, and the hazard of water erosion is severe. The hazard of soil blowing is slight. The root zone is deep, but the clayey lower layers restrict some root penetration.

Included with this soil in mapping are small areas of Hassee, Lindy, Minwells, and Thurber soils. Hassee and Thurber soils are in low, depressed spots. Lindy and Minwells are on convex uplands. These included soils are in areas of less than 5 acres and together make up less than 15 percent of any mapped area.

This Wichita soil is dominantly used as rangeland and is well suited to this use. The potential plant community is a prairie of tall and mid grasses. The predominant plants are—

- big bluestem and switchgrass—15 percent
- little bluestem—25 percent
- indiangrass—10 percent
- sideoats grama—10 percent.

Other important plants are—

- cane bluestem and silver bluestem—5 percent
- vine-mesquite—5 percent
- Texas wintergrass—5 percent
- forbs, such as Engelmann-daisy, bundleflower, prairie-clover, Maximilian sunflower, sensitivebrier, and halfshrub sundrop, make up the rest.

Big bluestem, switchgrass, indiangrass, and many perennial forbs are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. These plants are replaced by little bluestem, sideoats grama, cane bluestem, silver bluestem, vine-mesquite, and Texas wintergrass. Continued overgrazing causes an invasion of threeawn, Texas grama, annual grasses and weeds, lotebush, pricklypear, tasajillo, juniper, and mesquite.

Potential for wildlife habitat is fair. This area is inhabited by deer, dove, and quail. Several of the forbs and grasses provide seed for game birds and animals. A good selection of forbs for deer forage is available, but little cover and protection for escape and resting are provided.

This soil is well suited to use as cropland. Sorghum and small grain are adapted to this soil. Using terraces and diversions and leaving crop residue on the soil help to control erosion, conserve moisture, and maintain productivity. This soil is moderately well suited to use as pastureland. Kleingrass and King Ranch bluestem are adapted to this soil.

This Wichita soil is moderately well suited to most urban and recreation uses. Shrink-swell potential and moderately slow permeability are limitations that can be overcome by proper design and careful installation.

This soil is in capability subclass IIe and the Clay Loam range site.

51—Windthorst fine sandy loam, 1 to 3 percent slopes. This deep, moderately well drained, gently sloping soil is on convex ridges (fig. 23). Areas are irregular in shape and range from 15 to 100 acres.

Typically, the surface layer is slightly acid, brownish fine sandy loam about 10 inches thick. At a depth of 10 to 55 inches is medium acid, red clay that has reddish

Figure 23.—Profile of Windthorst fine sandy loam, 1 to 3 percent slopes. Depths are shown in feet.

and yellowish mottles in the lower part. Below that to a depth of 60 inches, is medium acid, yellowish red and light brown stratified clay and fine sandy loam.

Permeability is moderately slow, and available water capacity is high. Runoff is medium, and the hazard of water erosion is severe. The hazard of soil blowing is moderate. Tilth is poor. The soil can be worked well in a narrow range of moisture conditions. The root zone is deep, but the clayey lower layers restrict some root penetration. This soil responds well to fertilization.

Included with this soil in mapping are small areas of Bonti, Chaney, Hassee, and Truce soils. Bonti soils are on narrow ridges. Chaney and Hassee soils are on lower slopes and in slight depressions. Truce soils are on side slopes of ridgetops. The included soils are 1 to 10 acres and together make up about 15 percent of most mapped areas.

This Windthorst soil is dominantly used as cropland and is well suited to this use. Forage sorghum, grain sorghum, cotton, small grain, and peanuts are the main crops. Peaches and truck crops are grown in some areas. Using terraces, contour farming, and leaving crop residue on the soil help to control erosion and maintain productivity. Cultivation should be timely and limited. This soil is well suited to use as pastureland. Bermudagrass, kleingrass, and lovegrass are adapted to this soil.

This soil is well suited to use as rangeland. The potential plant community is a post oak savannah with an understory of tall and mid grasses. The predominant plants are—

- little bluestem—30 percent
- big bluestem and sand bluestem—10 percent
- indiangrass—10 percent
- sideoats grama—10 percent
- forbs, such as yellow neptunia, scurfpea, western ragweed, Engelmann-daisy, dotted gayfeather, bundleflower, dalea, and prairie-clover—10 percent
- post oak—10 percent.

Other important plants are cane bluestem, silver bluestem, Scribner panicum, Texas wintergrass, Arizona cottontop, and sand lovegrass and small amounts of blackjack oak, elm, pricklyash, bumelia, hackberry, sumac, live oak, elbowbush, greenbrier, and plums.

Big bluestem, indiangrass, switchgrass, and sand lovegrass are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. They are replaced by little bluestem and sideoats grama. Continued overgrazing causes these plants to be grazed out. Silver bluestem, hooded windmillgrass, and hairy grama would then increase. Further heavy grazing causes a decline in all of these plants and an invasion of threeawn, dropseed, red lovegrass, annual grasses, skunkbush sumac, and post oak. Mesquite, juniper, and catclaw can eventually take over and shade out most grasses.

Potential for wildlife habitat is good. This area is inhabited by deer, dove, quail, squirrels, and turkeys. Several of the woody plants, forbs, and grasses provide good cover, browse, mast, and seeds for game birds and animals.

This soil is moderately well suited to most urban uses. Shrink-swell potential and moderately slow permeability are limitations that can be overcome by using proper design and careful installation procedures.

This Windthorst soil is well suited to recreation uses.

This soil is in capability subclass IIe and the Sandy Loam range site.

52—Yahola and Gaddy soils, occasionally flooded. These deep, well drained and somewhat excessively drained, nearly level to gently undulating soils are on bottom lands adjacent to the Brazos River. The bottom lands are made up of the natural levee, the river banks, and the adjacent flood plains. Slopes are 0 to 5 percent. Areas are long and narrow along the riverbanks and range from 20 to 300 acres.

About 66 percent of the total acreage of this map unit is Yahola soil, 26 percent is Gaddy soil, and 8 percent is other soils. These soils are not uniform and do not occur in a regular pattern. A few of the mapped areas do not have the Gaddy soil.

Typically, the surface layer of the Yahola soil is light reddish brown very fine sandy loam about 8 inches thick. From a depth of 8 to 45 inches is very fine sandy loam that is reddish yellow in the upper part and reddish brown in the lower part. The next layer, to a depth of 52 inches, is reddish yellow silt loam. The underlying layer from a depth of 52 to 62 inches is pink loamy fine sand.

Permeability is moderately rapid, and available water capacity is high. This soil is well drained. Flooding occurs once or more often every 5 to 20 years. The root zone is deep and easily penetrated by plant roots. The hazard of water erosion is severe because of scouring during floods. The hazard of soil blowing is medium.

Typically, the surface layer of the Gaddy soil is pale brown, moderately alkaline loamy fine sand about 6 inches thick. From a depth of 6 to 38 inches is moderately alkaline, pink fine sand. At a depth of 38 to 44 inches is moderately alkaline, pink loamy fine sand. Below that to a depth of 62 inches is moderately alkaline, pink fine sand (fig. 24).

Permeability is rapid, and available water capacity is low. Flooding occurs once or more often every 5 to 20 years, mainly in spring or fall. Areas of this soil remain flooded for a few hours to several weeks. The hazard of water erosion is severe because of scouring during floods. The hazard of soil blowing is severe. The root zone is deep and easily penetrated by plant roots.

Included with these soils in mapping are areas of Apalo and Santo soils. Apalo soils are on slightly higher benches on adjacent terraces. Santo soils are on flood plains of streams draining local uplands. Also included are narrow areas of Yahola and Gaddy soils adjacent to the Brazos River that flood as often as once every year or every 2 years. These closely similar soils are 5 to 40

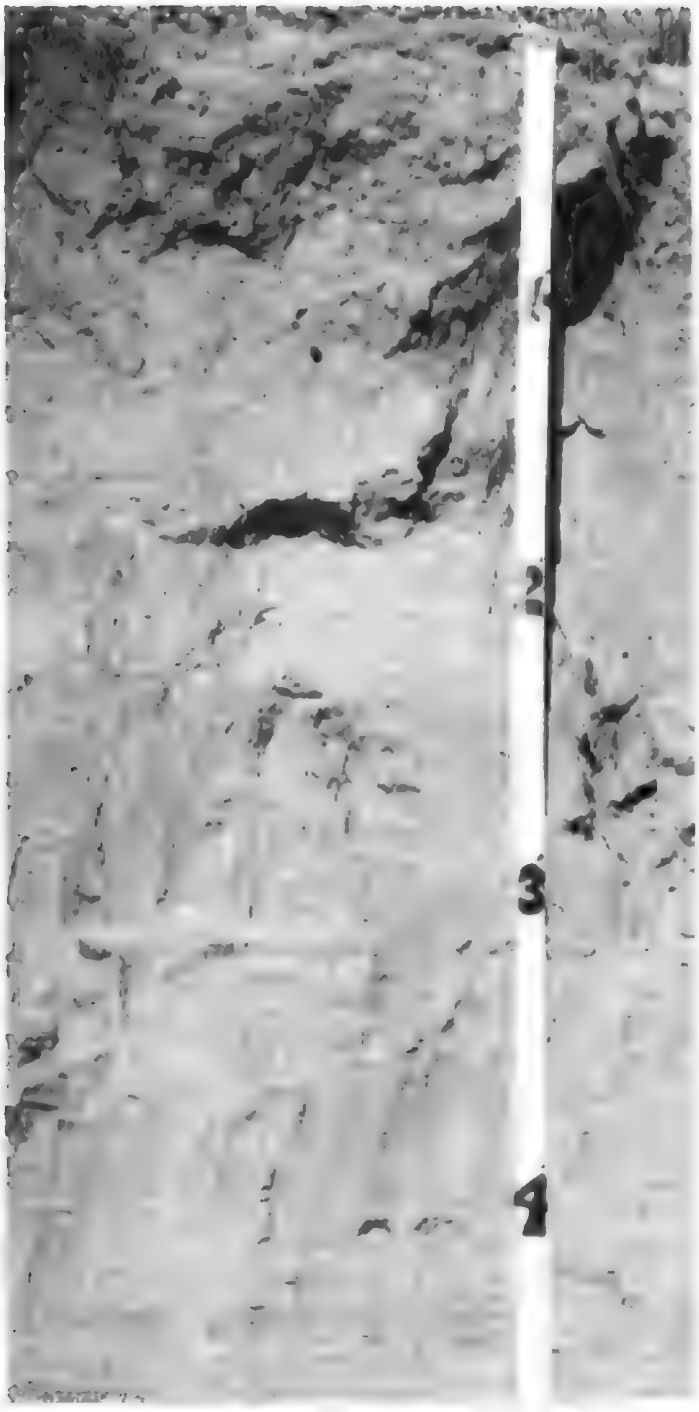


Figure 24.—Profile of Gaddy loamy fine sand. Stratifications of alluvial sediment are evident. Depths are shown in feet.

acres and make up less than 15 percent of any mapped area.

The Yahola and Gaddy soils are dominantly used as rangeland and are well suited to this use. The potential plant community on the Yahola soil is a tall grass bottom land with a 10 to 15 percent canopy of woody plants. The predominant plants are—

- indiangrass—20 percent
- big bluestem—10 percent
- switchgrass—15 percent
- little bluestem—15 percent.

The rest of this plant community is made up of forbs, such as Maximilian sunflower, Engelmann-daisy, trailing wildbean, Baldwin ironweed, catclaw sensitivebrier, trailing ratany, heath aster, gaura, and dalea; and woody plants, such as American elm, pecan, live oak, hackberry, cottonwood, bumelia, and elbowbush.

Indiangrass, big bluestem, and switchgrass on the Yahola soil are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. They are replaced by sideoats grama, dropseed, Texas wintergrass, and woody plants. Continued overgrazing causes a decrease of these plants, except for the woody plants which continue to increase along with an invasion of western ragweed, nightshade, common bermudagrass, and buffalograss.

The potential plant community on the Gaddy soil is a tall grass bottom land with a 5 to 10 percent woody canopy. The predominant plants are—

- switchgrass—30 percent
- sand bluestem—15 percent
- indiangrass—15 percent
- forbs, such as Maximilian sunflower, goldenrod, heath aster, and trailing wildbean—5 percent
- cottonwood and willow—10 percent.

Other plants are little bluestem, eastern gamagrass, Texas bluegrass, beaked panicum, purpletop tridens, and minor amounts of greenbrier, sycamore, and grapes.

Switchgrass, sand bluestem, indiangrass, and eastern gamagrass on the Gaddy soil are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. These plants are replaced by little bluestem, silver bluestem, Texas bluegrass, beaked panicum, and purpletop tridens. Continued overgrazing causes a decline of these plants along with an invasion of annual forbs and grasses, saltcedar, chinaberry, sand dropseed, hooded windmillgrass, and common bermudagrass.

Potential for wildlife habitat is good. This area is inhabited by deer, turkeys, dove, and quail. Turkeys commonly use the large trees for roosting. Many of the choice forage plants for deer and turkeys are produced on these soils. Excellent resting, nesting, and escape cover is also provided.

The Yahola and Gaddy soils are moderately well suited to use as cropland because of the hazard of flooding. Wheat and oats are the main crops. These soils are well suited to use as pastureland. Grasses, such as bermudagrass and lovegrass, are adapted to these soils.

The soils in this map unit are poorly suited to urban uses. The hazard of flooding is the main limitation.

These soils are moderately well suited to use for

picnic areas and paths and trails but poorly suited to use for more permanent camp areas and playgrounds. The hazard of flooding and the dusty surfaces are the main limitations.

The Yahola soil is in capability subclass IIw and the Loamy Bottomland range site. The Gaddy soil is in capabilty subclass IIIs and the Sandy Bottomland range site.

use and management of the soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland and woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

crops and pasture

H. T. Michael, district conservationist, Soil Conservation Service, helped prepare this section.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed soil map units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

Most of the soils in the western part of the county are shallow over hard limestone. These soils support abundant grasses, but potential productivity is medium because of the depth to rock and the low available water capacity. In much of the eastern part of the county, the soils are shallow to moderately deep over sandstone. These soils also support abundant grasses and have medium potential for productivity because of the shallow to moderately deep root zone and the low to medium available water capacity. Deep soils on flood plains, stream terraces, and in valleys have higher potential productivity than the shallower soils.

The major management concern on most of the rangeland is controlling grazing so that the kinds and amounts of plants that make up the potential plant community are reestablished and maintained. This plant cover increases water intake, prevents runoff and erosion, and increases forage production. Controlling brush is also an important management concern. If sound range management is applied, based on the information in this survey and rangeland inventories, potential is good for increasing the productivity of rangeland in this county.

About 40,000 acres of the survey area is used as cropland and pastureland, according to the local field office of the Soil Conservation Service. Of this total, about 1,700 acres is used for peanuts; 800 acres for cotton; 800 acres for grain sorghum; 6,000 acres for wheat, oats, and barley; and the rest is used as pastureland (fig. 25). Sunflower and guar can be grown when economic conditions are favorable.

The soils in Palo Pinto County have good potential for increased production of food. About 280,000 acres has potential for use as cropland (*7*). About 10,000 acres is presently farmed. Inadequate rainfall is a limitation.

The acreage used as cropland has gradually been decreasing as more and more land is being converted to pastureland or rangeland. The major pasture grasses are bermudagrass, kleingrass, and lovegrass.

Managing cropland and pastureland for high returns

Figure 25.—Fence-line contrast shows brush control and pasture planting in an area of Leeray clay, 0 to 1 percent slopes.

requires using the limited rainfall efficiently. When dry, many of the soils have a surface layer that is very hard and crusty. Many of them also take in rainwater slowly. These factors, in combination with slopes that are generally more than 1 percent, cause medium to rapid surface runoff which results in erosion and a reduction in crop yields.

Practices that reduce runoff and increase the water intake rate are needed. One of the most effective practices is maintaining a vegetative cover for extended periods. This improves soil tilth, increases the water intake rate, and reduces erosion. Terraces and diversions reduce the length of slopes and also help to reduce runoff and erosion.

Soil blowing is a hazard on sandy soils, such as Chaney, Patilo, Decordova, and Demona soils. Maintaining vegetative cover on these soils minimizes this hazard.

Proper grazing of pastureland and rangeland to insure adequate vegetative cover increases the water intake

rate, reduces erosion, and increases production. Information concerning many erosion control practices is available at the local offices of the Soil Conservation Service.

Soil fertility is naturally low in most sandy soils, in soils that have a loamy surface layer, and in those that are underlain by sandstone or shale. Most areas of these soils can be easily recognized by the presence of post oak trees. The main soils are Bonti, Truce, and Chaney soils.

The Bosque, Frio, and Santo soils are on flood plains, are naturally high in plant nutrients, and are alkaline. Leeray, Lindy, and Wichita soils range from neutral to alkaline. They are on uplands that are naturally high in plant nutrients. Areas of these soils in rangeland are recognized by the presence of live oak trees. The soils in the southeast and northeast corners of the county that have a sandy and loamy surface generally are not deficient in potassium because the clayey lower layers contain interstratified minerals of mica and montmorillonite. Mica is considered to be an important source of potassium (*6*).

yields per acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green-manure crops; and harvesting that insures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils.

land capability classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey. These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have slight limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the

subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

Capability units are soil groups within a subclass. The soils in a capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-4 or IIIe-6.

The acreage of soils in each capability class and subclass is shown in table 6. The capability classification of each map unit is given in the section "Detailed soil map units."

rangeland

Stanley L. Ellison, range specialist, Soil Conservation Service, helped prepare this section.

About 88 percent of Palo Pinto County, or 530,000 acres, is used as rangeland, according to the records of the local field office of the Soil Conservation Service. More than 91 percent of the agricultural income is derived from livestock, principally cattle. Cow-calf operations are dominant in the county. The average size of the ranches is about 1,200 acres (fig. 26).

Figure 26.—View from Truce-Bonti complex, extremely stony, 8 to 40 percent slopes, in the Sandstone Hill range site.

Figure 27.—The Sandstone Hill range site is in the background. Truce and Bonti soils are in the foreground. The Claypan Prairie range site is in the center and is mainly Thurber soils.

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between the soils and vegetation and water.

Table 7 shows, for each soil, the range site and the potential annual production of vegetation in favorable, normal, and unfavorable years. Only those soils that are used as or are suited to rangeland are listed. Explanation of the column headings in table 7 follows.

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was established during this survey; thus, range sites generally can be determined directly from the soil map (fig. 27). Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

Potential production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and

unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In a normal year, growing conditions are about average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only. It does not have a specific meaning that pertains to the present plant community in a given use.

The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the optimum production of vegetation, reduction of undesirable brush species, conservation of water, and control of water erosion and soil blowing. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

recreation

Edward M. Schwille, bioligist, Soil Conservation Service, helped prepare this section.

About 85 percent of the survey area is suited to commercial or noncommercial recreational activities. Potential is medium to high for recreational development.

Possum Kingdom Lake, Lake Palo Pinto, Tucker Lake, James Lake, Lone Star Lake, and several other smaller lakes provide fishing and other water related activities. Camping and picnic areas are also available. Many areas that are suited to recreation uses are along Palo Pinto Creek and the Brazos River, including the East and West Forks. Boating and canoeing on the Brazos River provide many recreational opportunities. Existing water areas are abundant and range from 10 to 100 acres. Limited accessibility reduces the potential for development of some scenic areas. White-tailed deer, turkeys, dove, and quail inhabit the area. Several state historical markers and sites are located throughout the survey area.

The soils of the survey area are rated in table 8 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 8, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 8 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 11 and interpretations for dwellings without basements and for local roads and streets in table 10.

Camp areas require site preparation such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking, horseback riding, and bicycling should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

wildlife habitat

Edward M. Schwille, biologist, Soil Conservation Service, helped prepare this section.

As a result of management of the habitat, wildlife is increasing. Special consideration is being given to the improvement of habitat for game and exotic species (figs. 28 and 29).

Major kinds of wildlife in the survey area are white-tailed deer, mourning dove, bobwhite quail, turkey, raccoon, opossum, striped skunk, ringtail cat, bobcat, coyote, red and grey fox, armadillo, fox squirrel, and numerous song birds, shore birds, and raptors.

During the migration periods, waterfowl such as mallard, pintail, teal, and others use existing water areas. Some wood ducks nest in the survey area. Fish such as largemouth bass, channel catfish, crappie, white bass, sunfish, carp, gar, flathead catfish, and minnows are abundant in ponds, lakes, streams, and rivers. Rainbow trout are released into the Brazos River below Possum Kingdom dam by the Texas Parks and Wildlife Department. Numerous reptiles and amphibians also thrive in this survey area.

The golden-cheeked warbler is the only creature on the list of threatened and endangered species that lives in the county. It lives in mature stands of Ashe juniper. During the migration period, bald and golden eagles have been sighted around Possum Kingdom Lake and along the Brazos River.

Many areas in the county can be improved for use as wildlife habitat by increasing the food and water supply and cover. Areas that are best suited to improvement for wildlife habitat are included in general soil map units 1, 2, 3, 5, and 6, which are described in the section "General soil map units."

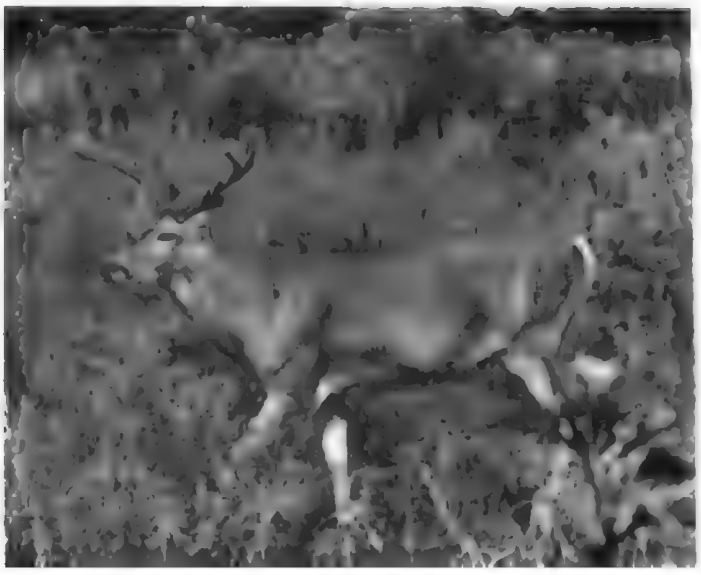


Figure 28.—White-tailed deer is the major game species in the county.

Figure 29.—Black buck antelope is one of the many exotic species managed for hunting.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 9, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, millet, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are kleingrass, lovegrass, switchgrass, clover, and vetch.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, dropseed, beggarweed, western ragweed, and sunflower.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, the available water capacity, and wetness. Examples of these plants are oak, pecan, apple, hawthorn, hickory and blackberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian-olive, autumn-olive, and crabapple.

Coniferous plants furnish browse, seeds, and cones. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, fir, cedar, and juniper.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are mesquite, elbowbush, sumac, greenbrier, and plum.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, buckwheat, common reedgrass, rushes, and sedges.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are waterfowl feeding areas and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite quail, deer, mourning dove, field sparrow, cottontail, and red fox.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, shore birds, raccoon, mink, and nutria.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include fox, deer, coyote, squirrels, bobwhite quail, dove, and turkeys.

engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science, engineering, and geology and are defined in the Glossary.

building site development

Table 10 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, and depth to a high water table affect the traffic supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

sanitary facilities

Table 11 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 11 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to effectively filter the effluent. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 11 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 11 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the

surface layer should be stockpiled for use as the final cover.

construction materials

Table 12 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 12, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

water management

Table 13 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site

features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; and susceptibility to flooding. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

soil properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 19.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

engineering index properties

Table 14 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil series and their morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains particles coarser than sand, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as Pt. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The AASHTO classification for soils tested, with group index numbers in parentheses, is given in table 19.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an oven-dry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

physical and chemical properties

Table 15 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion and the amount of soil lost. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.
2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to wind erosion.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 15, the estimated content of organic matter of the plow layer is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

soil and water features

Table 16 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt and water in swamps and marshes are not considered flooding.

Table 16 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 16 are the depth to the seasonal high water table; the kind of water table—that is,

perched, artesian, or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 16.

An apparent water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. An artesian water table is under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole. A perched water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

physical and chemical analyses of selected soils

The results of physical analysis of several typical pedons in the survey area are given in table 17 and the results of chemical analysis in table 18. The data are for soils sampled at carefully selected sites. The pedons are typical of the series and are described in the section "Soil series and their morphology." Soil samples were analyzed by National Soil Survey Laboratory, Soil Conservation Service, Lincoln, Nebraska.

Most determinations, except those for grain-size analysis and bulk density, were made on soil material smaller than 2 millimeters in diameter. Measurements reported as percent or quantity of unit weight were calculated on an oven-dry basis. The methods used in obtaining the data are indicated in the list that follows. The codes in parentheses refer to published methods (*9*).

Sand—(0.05-2.0 mm fraction) weight percentages of materials less than 2 mm (3A1).
Silt—(0.002-0.05 mm fraction) pipette extraction, weight percentages of all materials less than 2 mm (3A1).
Clay—(fraction less than 0.002 mm) pipette extraction, weight percentages of materials less than 2 mm (3A1).
Water retained—pressure extraction, percentage of oven-dry weight of less than 2 mm material; 1/3 or 1/10 (3/10) bar (4B1), 15 bars (4B2).
Moist bulk density—of less than 2 mm material, saran-coated clods (4A1).
Organic carbon—dichromate, ferric sulfate titration (6A1a).
Extractable cations—ammonium acetate pH 7.0, uncorrected; calcium (6N2), magnesium (602), sodium (6P2), potassium (6Q2).
Extractable acidity—barium chloride-triethanolamine I (6H1a).
Cation-exchange capacity—sum of cations (5A3a).
Base saturation—sum of cations, TEA, pH 8.2 (5C3).
Reaction (pH)—1:1 water dilution (8C1a).
Reaction (pH)—calcium chloride (8C1e).

engineering index test data

Table 19 shows laboratory test data for several pedons sampled at carefully selected sites in the survey area. The pedons are typical of the series and are described in the section "Soil series and their morphology." The soil samples were tested by Texas State Department of Highways and Public Transportation.

The testing methods generally are those of the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are: AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 423 (ASTM); Plasticity index—T 90 (AASHTO), D 424 (ASTM); Specific gravity (Particle index)—T 100 (AASHTO), D 653 (ASTM); Shrinkage—T 92 (AASHTO), D 427 (ASTM).

classification of the soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*10*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. In table 20, the soils of the survey area are classified according to the system. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Alfisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Ustalf (*Ust*, meaning burnt, plus *alf*, from Alfisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Haplustalfs (*Hapl*, meaning minimal horizonation, plus *ustalfs*, the suborder of the Alfisols that have an ustic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Haplustalfs.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine, montmorillonitic, thermic Typic Haplustalfs.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

soil series and their morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the Soil Survey Manual (*8*). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (*10*). Unless otherwise stated, colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed soil map units."

Apalo series

The Apalo series consists of deep, well drained, upland soils that are on loamy terraces along the Brazos River. These soils formed in stratified alluvium. Slopes range from 1 to 8 percent.

Typical pedon of Apalo very fine sandy loam, 1 to 3 percent slopes; about 10 miles south of Mineral Wells on U. S. Highway 281 near the Brazos River bridge, from the northeast end of the highway bridge, 0.25 mile northeast; site is 150 feet west of fence in bermudagrass pasture:

Ap—0 to 8 inches; reddish brown (5YR 5/3) very fine sandy loam, reddish brown (5YR 4/3) moist; weak medium subangular blocky structure; slightly hard, friable; many fine roots; few medium roots; common fine pores; few fine worm casts; neutral; abrupt smooth boundary.

A1—8 to 19 inches; reddish brown (5YR 5/4) very fine sandy loam, reddish brown (5YR 4/4) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; slightly hard, friable; many fine roots; many fine pores, few medium pores; many fine worm casts; neutral; clear wavy boundary.

B21—19 to 28 inches; yellowish red (5YR 5/6) very fine sandy loam, yellowish red (5YR 4/6) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; slightly hard, friable; many fine roots; many fine pores, common medium pores; many fine and medium worm casts; neutral; gradual wavy boundary.

B22—28 to 52 inches; yellowish red (5YR 5/6) very fine sandy loam, yellowish red (5YR 4/6) moist; weak coarse prismatic structure parting to moderate coarse subangular blocky; slightly hard, friable; common fine roots; many fine pores, few medium pores; many fine worm casts; neutral, clear wavy boundary.

B3ca—52 to 80 inches; yellowish red (5YR 5/6) loam, yellowish red (5YR 4/6) moist; weak coarse prismatic structure parting to coarse subangular blocky; slightly hard, friable; few fine roots; many fine pores; common fine worm casts; common films and threads of calcium carbonate on surfaces of prisms; few soft masses and concretions of calcium carbonate; calcareous; moderately alkaline.

Solum thickness is more than 60 inches. Secondary carbonates are below a depth of 28 inches. Texture is very fine sandy loam or loam.

The A horizon is brown, reddish brown, light brown, light reddish brown, reddish yellow, or yellowish red. Reaction is slightly acid or neutral.

The B2 horizon is reddish brown, yellowish red, light reddish brown, or reddish yellow. Reaction is neutral or mildly alkaline in the upper part and ranges from neutral to moderately alkaline in the lower part. Some pedons contain a few films and threads of calcium carbonate in the lower part of this horizon.

The B3ca horizon is in shades of red, brown, or yellow. Films, threads, soft masses, and concretions of calcium carbonate range from few to common.

Bastrop series

The Bastrop series consists of deep, well drained soils that formed on loamy and sandy stream terraces over thick reddish beds of loamy alluvial sediment. Slopes range from 1 to 5 percent.

Typical pedon of Bastrop fine sandy loam, 1 to 3 percent slopes; south of Mineral Wells, from the intersection of Interstate Highway 20 and U. S. Highway 281, north on U. S. Highway 281 to the west end of the Brazos River bridge, and 0.8 mile north-northeast on U. S. Highway 281; site is west of the highway and 60 feet from a fence:

Ap—0 to 10 inches; brown (7.5YR 5/4) fine sandy loam, brown (7.5YR 4/4) moist; weak fine subangular blocky structure; slightly hard, friable; many fine roots and common medium roots; common very fine pores; few medium rounded siliceous pebbles; slightly acid; abrupt smooth boundary.

A1—10 to 13 inches; reddish brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; weak medium and fine subangular blocky structure; slightly hard, friable; many fine roots and few medium roots; common very fine pores; few mole burrows up to 2-1/2 inches in diameter; few fine worm casts; few medium rounded siliceous pebbles; slightly acid; clear wavy boundary.

B21t—13 to 20 inches; reddish brown (5YR 4/4) sandy clay loam, reddish brown (5YR 4/4) moist; compound strong coarse prismatic structure and moderate medium subangular blocky; hard, friable; many fine roots and few medium roots; many very fine pores; many fine worm casts; few worm nests and holes filled with slightly darker soil; few medium rounded siliceous pebbles; neutral; gradual wavy boundary.

B22t—20 to 30 inches; yellowish red (5YR 4/6) sandy clay loam, yellowish red (5YR 4/6) moist; dark reddish brown (5YR 3/4) films on the faces of prisms; compound strong coarse prismatic structure and moderate medium subangular blocky; hard, firm; many fine roots; few medium roots; many very fine and fine pores; common thin clay films on faces of prisms; many fine worm casts; few krotovinas as much as 0.5 inch in diameter; few medium rounded siliceous pebbles; neutral; gradual wavy boundary.

B23t—30 to 50 inches; yellowish red (5YR 4/6) sandy clay loam, yellowish red (5YR 4/6) moist, with reddish brown (5YR 4/4) films on the faces of prisms; compound strong coarse prismatic structure and moderate medium subangular blocky; hard, firm; common fine roots and few medium roots; many very fine and fine pores; common thin clay films on faces of prisms; many fine and very fine worm casts; few medium rounded siliceous pebbles; neutral; gradual wavy boundary.

B24t—50 to 72 inches; yellowish red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; compound moderate coarse prismatic structure and moderate medium and coarse subangular blocky; hard, firm; few fine roots; many very fine pores and few fine pores; common fine worm casts; few medium rounded and angular siliceous pebbles; neutral; clear wavy boundary.

B3ca—72 to 80 inches; yellowish red (5YR 5/8) sandy clay loam, yellowish red (5YR 4/8) moist; compound weak coarse prismatic structure and moderate medium and coarse subangular blocky; hard, friable; few fine roots; common very fine and fine pores; few very fine worm casts; few medium rounded siliceous pebbles and few fragments of calcareous sandstone; few films and threads of calcium carbonate on faces of prisms; calcareous; neutral.

Solum thickness ranges from 60 to about 90 inches. The A horizon is fine sandy loam or loamy fine sand. It is reddish brown, light reddish brown, yellowish red, light brown, reddish yellow, brown, or pale brown. Reaction ranges from medium acid to neutral. Thickness ranges from 6 to 18 inches.

The Bt horizon is yellowish red, reddish yellow, reddish brown, or red sandy clay loam or loam. Reaction ranges from slightly acid to mildly alkaline.

The depth to the stratified C horizon is more than 60 inches. The C horizon ranges from reddish yellow to yellowish red sandy clay loam, loam, or fine sandy loam. Reaction ranges from neutral to moderately alkaline.

Blanket series

The Blanket series consists of deep, well drained soils that formed in loamy calcareous outwash and ancient stream alluvium in broad valleys. Slopes are 0 to 1 percent.

Typical pedon of Blanket clay loam, 0 to 1 percent slopes; from the intersection of Interstate Highway 20 and U. S. Highway 281, about 14 miles south of Mineral Wells, 1,600 feet south on U. S. Highway 281, and 1,200 feet east in pasture:

Ap—0 to 4 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure and weak medium granular; many fine roots; hard, firm; mildly alkaline; clear smooth boundary.

A1—4 to 18 inches; very dark grayish brown (10YR 3/2) clay loam, very dark brown (10YR 2/2) moist; moderate fine subangular blocky structure and moderate medium granular; hard, firm; many fine roots; mildly alkaline; clear smooth boundary.

B21t—18 to 26 inches; very dark grayish brown (10YR 3/2) clay loam, very dark brown (10YR 2/2) moist; moderate medium blocky structure; very hard, very firm; few fine roots; few fine pores; few patchy clay films on faces of peds; mildly alkaline; gradual smooth boundary.

B22t—26 to 32 inches; brown (10YR 4/3) clay loam, dark brown (10YR 3/3) moist; moderate medium blocky structure; very hard, very firm; few fine roots; few fine pores; patchy clay films on faces of peds; mildly alkaline; gradual smooth boundary.

B3ca—32 to 46 inches; brown (10YR 5/3) clay loam, brown (10YR 4/3) moist; weak medium subangular blocky structure; hard, firm; few fine roots; common masses and soft concretions of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

Cca—46 to 60 inches; light brownish gray (10YR 6/2) clay loam, dark grayish brown (10YR 4/2) moist; common fine and medium yellowish brown (10YR 5/4) mottles; massive; hard, firm; few fine roots; many films and threads and common soft masses of calcium carbonate; calcareous; moderately alkaline.

Solum thickness ranges from 40 to 80 inches. Secondary carbonates in the form of films, threads, or soft masses are at a depth of more than 28 inches. Some pedons contain a few siliceous pebbles throughout.

The A horizon is brown, dark brown, grayish brown, dark grayish brown, very dark grayish brown, or very dark brown. Reaction ranges from slightly acid to mildly alkaline.

The B21t horizon is brown, dark brown, grayish brown, dark grayish brown, very dark grayish brown, or very dark brown. Reaction ranges from slightly acid to mildly alkaline.

The B22t horizon has the same range in color as the B21t horizon, but some pedons are slightly darker when moist. Reaction ranges from slightly acid to moderately alkaline.

The B3ca and Cca horizons are light gray, light brownish gray, grayish brown, very pale brown, pale brown, yellowish brown, dark brown, or brown. The Cca horizon contains 10 to 30 percent calcium carbonate in the form of films, threads, soft masses, or concretions.

Bonti series

The Bonti series consists of moderately deep, well drained soils that formed in material weathered from sandstone on uplands. Slopes range from 1 to 40 percent.

Typical pedon of Bonti very stony fine sandy loam in an area of Bonti-Exray complex, very stony, 1 to 8 percent slopes; from the intersection of a railroad crossing and Farm Road 129 in the town of Brazos, west on Farm Road 129 for 1.7 miles, 3.2 miles north on county road, and 21 feet north in rangeland:

A1—0 to 2 inches; dark grayish brown (10YR 4/2) very stony fine sandy loam, very dark grayish brown (10YR 3/2) moist; massive; hard, friable; few fine roots; sandstone fragments 10 to 36 inches in diameter cover about 10 percent of soil surface; neutral; clear smooth boundary.

A2—2 to 5 inches; light yellowish brown (10YR 6/4) fine sandy loam, yellowish brown (10YR 5/4) moist; massive; hard, friable; few fine roots; 10 percent by volume rounded quartz pebbles 2 to 6 millimeters in diameter; slightly acid; abrupt smooth boundary.

B21t—5 to 18 inches; red (2.5YR 4/6) clay, dark red (2.5YR 3/6) moist; moderate fine angular blocky structure; very hard, firm; few fine roots; thin continuous clay films on faces of peds; few sandstone fragments 2 to 4 inches in diameter; medium acid; gradual smooth boundary.
B22t—18 to 24 inches; red (2.5YR 5/6) clay, red (2.5YR 4/6) moist; few fine distinct dark red and few fine faint reddish yellow mottles; moderate fine angular blocky structure; very hard, very firm; few fine roots; thin continuous clay films on faces of peds; strongly acid; wavy boundary.
R—24 to 26 inches; brownish yellow sandstone.

Solum thickness and depth to bedrock range from 20 to 40 inches. Sandstone fragments, 1 inch to 24 inches in diameter, cover as much as 30 percent of the surface in some areas, but in some areas the surface does not have stone fragments.

The A1 horizon is dark grayish brown, grayish brown, brown, yellowish brown, or dark yellowish brown. The A2 horizon is brown, pale brown, light yellowish brown, light brown, grayish brown, or reddish yellow. Reaction in the A horizon ranges from medium acid to neutral. Sandstone and quartz fragments less than 3 inches in diameter range from 0 to 10 percent, by volume.

The Bt horizon is clay loam, sandy clay, or clay. It has 35 to 45 percent clay content. Reaction is strongly acid or medium acid. Base saturation ranges from about 50 to 75 percent. Coarse fragments range from 0 to 10 percent, by volume, and are mainly less than 3 inches in diameter. The B21t horizon is red, yellowish red, reddish brown, or light reddish brown. The B22t horizon is red, yellowish red, reddish brown, or light reddish brown. It commonly has a few dark red, reddish yellow, strong brown, or yellowish brown mottles.

The R layer is strongly cemented to indurated sandstone.

Bosque series

The Bosque series consists of deep, well drained soils that formed in loamy alluvium on bottom lands. Slopes are 0 to 1 percent.

Typical pedon of Bosque clay loam, occasionally flooded; east of the town of Strawn, from the junction of State Highway 16 and Walnut Street in Strawn, 2.7 miles east on Walnut Street and county road, and 200 feet northeast in cropland:

Ap—0 to 8 inches; brown (10YR 5/3) clay loam, dark brown (10YR 3/3) moist; moderate fine and medium granular structure; hard, friable; few roots and pores; calcareous; moderately alkaline; abrupt smooth boundary.
A12—8 to 28 inches; brown (10YR 4/3) clay loam, dark brown (10YR 3/3) moist; moderate fine and medium granular structure; hard, friable; few fine roots; few fine pores; calcareous; moderately alkaline; gradual wavy boundary.
A13—28 to 34 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; hard, friable; few fine roots; few fine pores; few films and threads of calcium carbonate; calcareous; moderately alkaline; gradual wavy boundary.
B2—34 to 50 inches; brown (10YR 5/3) clay loam, brown (10YR 4/3) moist; weak subangular blocky structure; hard, firm; few fine roots; few fine pores; many films and threads of calcium carbonate; calcareous; moderately alkaline; gradual wavy boundary.
C—50 to 60 inches; yellowish brown (10YR 5/4) clay loam, dark yellowish brown (10YR 4/4) moist; massive; hard, firm; few fine roots; many films and threads of calcium carbonate; thin faint bedding planes; calcareous; moderately alkaline.

The average texture of the 10- to 40-inch control section ranges from loam to clay loam. Clay content ranges from 20 to 35 percent.

The A horizon is brown, dark brown, grayish brown, dark grayish brown, or very dark grayish brown. It is mildly alkaline or moderately alkaline and calcareous. The mollic epipedon ranges from 20 to 50 inches in thickness.

The B2 horizon is light brown, brown, pale brown, very pale brown, grayish brown, light brownish gray, or light yellowish brown.

The C horizon ranges from loam to clay in shades of yellow and brown.

Chaney series

The Chaney series consists of deep, moderately well drained soils that formed in clayey to sandy materials on interbedded sandstone and shale on uplands. Slopes range from 1 to 5 percent.

Typical pedon of Chaney loamy fine sand, 1 to 5 percent slopes; 16 miles southeast of Mineral Wells, from the junction of U. S. 281 and Texas Highway 4, 3 miles east on Texas Highway 4 and 1.9 miles north on county road; site is west of road, 50 feet from fence:

A1—0 to 6 inches; pale brown (10YR 6/3) loamy fine sand, brown (10YR 5/3) moist; single grain; slightly hard, very friable; many fine roots; few fine quartz pebbles; slightly acid; clear smooth boundary.
A2—6 to 16 inches; very pale brown (10YR 7/3) loamy fine sand, pale brown (10YR 6/3) moist; single grain; slightly hard, very friable; many fine roots; few fine quartz pebbles; slightly acid; abrupt wavy boundary.
B21t—16 to 30 inches; red (2.5YR 5/6) sandy clay, red (2.5YR 4/6) moist; common medium prominent light brownish gray (10YR 6/2) and few fine and medium

distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; extremely hard, very firm; few fine roots; few fine pores; few fine siliceous pebbles; common clay films on faces of peds; slightly acid; gradual wavy boundary.

B22t—30 to 45 inches; brownish yellow (10YR 6/6) clay, yellowish brown (10YR 5/6) moist; common medium distinct grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; extremely hard, very firm; few fine roots; few fine pores; few fine siliceous pebbles; common clay films; few black concretions; slightly acid; gradual wavy boundary.

C—45 to 60 inches; reddish yellow (7.5YR 6/6) clay, strong brown (7.5YR 5/6) moist, common medium distinct mottles of grayish brown (10YR 5/2); massive; extremely hard, firm; few fine roots; few fine siliceous pebbles; few soft films and soft masses of calcium carbonate; moderately alkaline.

Solum thickness ranges from 30 to 60 inches. The A horizon ranges from 6 to 20 inches in thickness and from medium acid to neutral in reaction.

The A1 horizon is light brown, brown, grayish brown, dark grayish brown, yellowish brown, light yellowish brown, pale brown, very pale brown, or light brownish gray.

The A2 horizon ranges from 1 unit to 3 units of value higher than the A1 horizon. In cultivated areas, the A1 and A2 horizons are generally mixed by tillage.

The Bt horizon is reddish brown, red, dark red, yellowish red, yellow, reddish yellow, light brown, strong brown, yellowish brown, or brownish yellow. In some pedons the Bt horizon is mottled in shades of red, yellow, brown, and gray throughout. Texture is sandy clay or clay with clay content ranging from 35 to 50 percent. Reaction ranges from medium acid to neutral.

The B3 horizon, if present, has brownish yellow, red, pale brown, light gray, or gray mottles. It is sandy clay loam or sandy clay.

The C horizon ranges from sandy loam to shaly clay. Some pedons have thin, weakly cemented, discontinuous sandstone layers. Reaction ranges from medium acid to moderately alkaline. In some pedons there are a few films, threads, or soft masses of calcium carbonate.

Decordova series

The Decordova series consists of deep, well drained soils on sandy terraces of the Brazos River. These soils formed in thick beds of loamy or sandy alluvium that have been reworked by wind. Slopes range from 0 to 5 percent.

Typical pedon of Decordova loamy fine sand, 0 to 5 percent slopes; southwest of the city of Mineral Wells, from the intersection of U. S. Highway 281 and U. S. Highway 180 in Mineral Wells, 3 miles west on U. S. Highway 180, 2 miles south on paved county road, about 1 mile southwest to house at end of road, and 550 feet northwest of the house; site is in northeast corner of bermudagrass pasture:

Ap—0 to 6 inches; light brown (7.5YR 6/4) loamy fine sand, brown (7.5YR 5/4) moist; single grain and weak medium subangular structure; slightly hard, very friable; many fine and medium roots; few fine pores; few krotovinas from 1-1/2 to 2 inches in diameter; few medium rounded siliceous pebbles; slightly acid; abrupt wavy boundary.

B21t—6 to 14 inches; reddish brown (5YR 5/3) fine sandy loam, reddish brown (5YR 4/3) moist; compound moderate coarse prismatic structure and moderate coarse subangular blocky; hard, friable; weakly compacted; many fine and medium roots; few very fine pores; few fine worm casts; common krotovinas up to 1-1/2 inches in diameter; thin continuous clay films and bridging on sand grains; few wavy dark red (2.5YR 3/6) lamellae of fine sandy loam that range from 4 to 7 millimeters in thickness; few medium rounded siliceous pebbles; neutral; clear wavy boundary.

B22t—14 to 23 inches; yellowish red (5YR 4/6) fine sandy loam, reddish brown (5YR 4/4) moist; weak coarse subangular blocky structure; slightly hard, friable; many fine and medium roots; many very fine pores; dark reddish brown (2.5YR 3/4) sandy clay loam lamellae bands throughout that range from 3 to 7 millimeters in thickness and total 15 millimeters; thin patchy clay films and bridgings on sand grains; slightly acid; gradual wavy boundary.

B23t—23 to 33 inches; yellowish red (5YR 4/6) fine sandy loam, reddish brown (5YR 4/4) moist; weak coarse subangular blocky structure; slightly hard, friable; many fine and medium roots; many very fine and fine pores; few krotovinas up to 2 inches in diameter; common fine worm casts; thin patchy clay films and bridgings on sand grains; few medium rounded siliceous pebbles; neutral; gradual wavy boundary.

B24t—33 to 49 inches; yellowish red (5YR 5/6) fine sandy loam, yellowish red (5YR 4/6) moist; weak coarse subangular blocky structure; slightly hard, friable; common fine roots; many very fine and fine pores; thin patchy clay films and bridgings on sand grains; few pockets of uncoated sand grains; few krotovinas up to 1-1/2 inches in diameter; common fine worm casts; few medium siliceous pebbles; few gopher holes about 1-1/2 to 2 inches in diameter; neutral; gradual wavy boundary.

B25t—49 to 80 inches; yellowish red (5YR 5/6) fine sandy loam, yellowish red (5Y 4/6) moist; weak coarse subangular blocky structure; slightly hard, very friable; common fine roots; many very fine and fine pores; thin patchy clay films and bridgings on sand grains; few pockets of uncoated sand grains;

few fine worm casts; few medium rounded siliceous pebbles; slightly acid.

Solum thickness is more than 60 inches. Small siliceous pebbles range from none to about 10 percent, by volume.

The A horizon is light brown, brown, light yellowish brown, or dark brown. It ranges from medium acid to neutral.

The Bt horizon is yellowish red, reddish yellow, strong brown, red, or reddish brown. It is fine sandy loam or loam with clay content of less than 18 percent. Most pedons contain skeletans of uncoated sand in the lower part. Reaction ranges from medium acid to neutral. Some pedons are moderately alkaline and calcareous in the lower part of this horizon.

Demona series

The Demona series consists of deep, moderately well drained soils that formed in sandy to clayey deposits on uplands. Slopes range from 0 to 5 percent.

Typical pedon of Demona loamy sand, 0 to 5 percent slopes; from the junction of Farm Road 4 and U. S. Highway 281 in the southeastern part of the county, 1.4 miles west on Farm Road 4, and 50 feet south in pasture:

A1—0 to 6 inches; brown (10YR 5/3) loamy sand, dark brown (10YR 4/3) moist; single grain; slightly hard, very friable; many fine roots; few rounded siliceous pebbles; neutral; clear smooth boundary.

A2—6 to 26 inches; very pale brown (10YR 7/3) loamy sand, pale brown (10YR 6/3) moist; structureless, single grain; slightly hard, loose; many fine roots; few rounded siliceous pebbles; slightly acid; abrupt wavy boundary.

B21t—26 to 36 inches; red (2.5YR 5/8) sandy clay, red (2.5YR 4/8) moist; common medium distinct (10YR 7/2) light gray mottles; moderate medium blocky structure; very hard, very firm; few fine roots; few fine pores; many distinct clay films on faces of peds; strongly acid; gradual smooth boundary.

B22t—36 to 48 inches; brownish yellow (10YR 6/6) sandy clay, yellowish brown (10YR 5/6) moist with common medium distinct mottles of yellowish red (5YR 5/6) and light brownish gray (10YR 6/2); moderate medium blocky structure; very hard, very firm; few fine roots; few fine pores; many distinct clay films on faces of peds; strongly acid; gradual smooth boundary.

B23t—48 to 54 inches; brownish yellow (10YR 6/6) sandy clay, yellowish brown (10YR 5/6) moist with common medium distinct mottles of yellowish red (5YR 5/6) and light brownish gray (10YR 6/2); weak coarse blocky structure; hard, firm; few fine roots; few fine pores; few faint clay films on faces of peds; medium acid; gradual smooth boundary.

B3—54 to 62 inches; light gray (10YR 7/2) clay, light brownish gray (10YR 6/2) moist; weak medium subangular blocky structure; extremely hard, extremely firm; few fine roots; medium acid.

Solum thickness ranges from 50 to more than 80 inches.

The combined thickness of the A1 and A2 horizons ranges from 20 to 40 inches. The A1 horizon is grayish brown, light yellowish brown, brown, pale brown, light brown, very pale brown, or light gray. The A2 horizon is pale brown, very pale brown, light gray, or light brown. Reaction ranges from medium acid to neutral.

The B2t horizon is red, light gray, and brownish yellow with varied amounts of red, yellow, brown, and gray mottles. Reaction ranges from strongly acid to slightly acid.

The B3 horizon is red, light gray, brownish yellow, or reddish yellow with varied amounts of red, yellow, and gray mottles. Reaction ranges from strongly acid to slightly acid.

Eufaula series

The Eufaula series consists of deep, somewhat excessively drained soils that formed in thick, sandy eolian sediment on terraces. Slopes range from 5 to 8 percent.

Typical pedon of Eufaula loamy fine sand, 5 to 8 percent slopes; 3 miles west of the city of Mineral Wells to intersection of U. S. Highway 180 and Texas Highway 337, 1 mile west on U. S. Highway 180, 2 miles south on county road; site is 100 feet east of road in pasture:

Ap—0 to 8 inches; very pale brown (10YR 7/3) loamy fine sand, pale brown (10YR 6/3) moist; single grain; slightly hard, very friable; many fine roots; slightly acid; clear smooth boundary.

A21—8 to 45 inches; pink (7.5YR 8/4) loamy fine sand, light brown (7.5YR 6/4) moist; single grain; loose; few fine roots; slightly acid; clear wavy boundary.

A22&B2t—45 to 80 inches; pink (7.5YR 7/4) loamy fine sand (A22), strong brown (7.5YR 5/6) moist; single grain; loose; lamellae of reddish yellow (5YR 6/6) loamy fine sand and fine sandy loam (B2t); the lamellae are massive, slightly hard, friable, wavy and discontinuous, 1/4 inch to 1-1/2 inches thick, 2 to 6 inches apart, and have clay bridgings between the sand grains; few fine roots; slightly acid.

Solum thickness is 72 inches or more. The A1 or Ap horizon is brown, very pale brown, light brown, or light yellowish brown. It is fine sand or loamy fine sand and is single grain or has weak granular structure. This horizon is loose or slightly hard and ranges from medium acid to neutral.

The A2 horizon is pink, light brown, light reddish brown, or reddish yellow. It is fine sand or loamy fine

sand. The A21 horizon ranges from medium acid to neutral, and the A22 horizon ranges from strongly acid to slightly acid.

The B2t horizon (lamellae) is reddish yellow, yellowish red, red, light red, or strong brown. Texture is fine sandy loam or loamy fine sand but averages loamy fine sand. The B2t horizon in some pedons is continuous loamy fine sand that ranges from 2 to 8 inches thick. It is predominantly massive, but in some pedons it has weak subangular blocky structure. This horizon ranges from strongly acid to slightly acid.

Exray series

The Exray series consists of shallow, well drained, stony soils that formed in material weathered from sandstone on uplands. Slopes range from 1 to 8 percent.

Typical pedon of Exray very stony fine sandy loam, in an area of Bonti-Exray complex, very stony, 1 to 8 percent slopes; from a railroad crossing in Brazos, 1.7 miles west on Farm Road 129, 3.2 miles north on county road, and 140 feet north in rangeland:

A1—0 to 3 inches; brown (10YR 4/3) very stony fine sandy loam, dark brown (10YR 3/3) moist; massive; hard, friable; few fine roots; few fine siliceous pebbles; sandstone fragments, 10 to 36 inches in diameter, cover 5 to 15 percent of surface; slightly acid; clear smooth boundary.

A2—3 to 5 inches; yellowish brown (10YR 5/4) fine sandy loam, dark yellowish brown (10YR 4/4) moist; massive; hard, friable; few fine roots; common fine siliceous pebbles; slightly acid; abrupt smooth boundary.

B2t—5 to 16 inches; red (2.5YR 4/6) clay, dark red (2.5YR 3/6) moist; moderate fine angular blocky structure; very hard, very firm; few fine roots; few fine pores; thin continuous clay films on faces of peds; few sandstone fragments range from 2 to 6 inches in diameter; medium acid; abrupt wavy boundary.

R—16 to 17 inches; brownish yellow sandstone.

Solum thickness of is 10 to 20 inches. Gravel and stones make up 1 to 30 percent, by volume. The A1 horizon is dark grayish brown, brown, dark brown, pale brown, strong brown, reddish yellow, yellowish brown, or dark yellowish brown. Reaction is neutral or slightly acid.

The A2 horizon is brown, dark brown, grayish brown, light brownish gray, yellowish brown, or light yellowish brown. Reaction is neutral or slightly acid.

The B2t horizon is dark red, red, reddish brown, or dark reddish brown. Texture is clay loam, sandy clay, or clay with clay content ranging from 35 to 50 percent. Reaction is slightly acid or medium acid.

The underlying sandstone is strongly cemented to indurated.

Frio series

The Frio series consists of deep, well drained soils that formed in loamy and clayey alluvium on flood plains. Slopes are 0 to 1 percent.

Typical pedon of Frio clay loam, occasionally flooded; from a railroad crossing in the town of Gordon, 3.3 miles north on Farm Road 919, and 0.8 mile east on a county road; site is 1,500 feet south of road in a field on bottom land:

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine and medium granular structure; hard, firm; many medium roots and pores; moderately alkaline; calcareous; abrupt smooth boundary.

A12—8 to 20 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; hard, firm; many medium roots and pores; moderately alkaline; calcareous; gradual wavy boundary.

A13—20 to 40 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; hard, firm; common fine roots and pores; moderately alkaline; calcareous; gradual wavy boundary.

B2—40 to 60 inches; pale brown (10YR 6/3) clay loam, brown (10YR 4/3) moist; moderate medium subangular blocky structure; hard, firm; few fine roots and pores; common films and threads of calcium carbonate; moderately alkaline; calcareous.

The calcium carbonate equivalent of the 10- to 40-inch control section ranges from 10 to 40 percent. COLE in the upper 50 inches of the soil ranges from 0.03 to 0.07. Gravel, sand, or limestone strata are below a depth of 6 feet.

The A horizon is brown, dark brown, grayish brown, dark grayish brown, or very dark grayish brown. Clay content ranges from 35 to 50 percent. Structure is strong or moderate subangular blocky and strong or moderate granular. The control section of some pedons contains 5 to 15 percent, by volume, pebbles and cobbles of limestone and chert. Some pedons do not have a B horizon.

Gaddy series

The Gaddy series consists of deep, somewhat excessively drained soils that formed in stratifed, sandy river alluvium on bottom lands. Slopes range from 0 to 5 percent.

Typical pedon of Gaddy loamy fine sand, in an area of Yahola and Gaddy soils, occasionally flooded; from the junction of U. S. Highway 281 and U. S. Highway 180 in Mineral Wells, 8.3 miles west on U. S. Highway 180, 4.1 miles south and east on county road, and 1.5 miles south and east along pasture road to riverbank:

A1—0 to 6 inches; pale brown (10YR 6/3) loamy fine sandy, brown (10YR 5/3) moist; single grain; loose moist and dry; many fine roots; moderately alkaline; calcareous; abrupt smooth boundary.
C1—6 to 38 inches; pink (7.5YR 7/4) fine sand, light brown (7.5YR 6/4) moist; single grain; loose moist and dry; common fine roots; prominent bedding planes; moderately alkaline; calcareous; abrupt smooth boundary.
C2—38 to 44 inches; pink (7.5YR 7/4) loamy fine sand, brown (7.5YR 5/4) moist; single grain; loose moist and dry; few fine roots; prominent bedding planes; moderately alkaline; calcareous; abrupt smooth boundary.
C3—44 to 62 inches; pink (7.5YR 7/4) fine sand, light brown (7.5YR 6/4) moist; single grain; loose moist and dry; prominent bedding planes and thin strata; moderately alkaline; calcareous.

The Ap or A1 horizon is brown, light brown, reddish yellow, grayish brown, pale brown, dark yellowish brown, or light yellowish brown.

The C horizon is light brown, pink, reddish yellow, pale brown, light yellowish brown, very pale brown, brownish yellow, or yellow. Texture is loamy fine sand or fine sand with thin strata of finer or coarser material.

Hassee series

The Hassee series consists of deep, somewhat poorly drained soils that formed in clayey calcareous sediment on uplands. Slopes are 0 to 1 percent.

Typical pedon of Hassee loam, 0 to 1 percent slopes; about 7 miles south of Palo Pinto near Lone Camp; from the junction of Farm Road 4 and Farm Road 3127, 1.8 miles west to a metal fence gate, 1.2 miles west, and 4,000 feet north along powerline right-of-way in native rangeland:

A1—0 to 8 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; massive; very hard, friable; few fine roots; neutral; clear smooth boundary.
A2g—8 to 10 inches; light gray (10YR 6/1) loam, gray (10YR 5/1) moist; massive; very hard, friable; few fine roots; neutral; abrupt wavy boundary.
B21tg—10 to 30 inches; very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; strong medium blocky structure; extremely hard, very firm; few fine roots; continuous clay films on ped faces; mildly alkaline; gradual wavy boundary.
B22tg—30 to 45 inches; gray (10YR 5/1) clay, dark gray (10YR 4/1) moist; moderate medium blocky structure; extremely hard, very firm; few fine roots; continuous clay films on ped faces; few concretions of calcium carbonate; moderately alkaline; calcareous; gradual wavy boundary.
B23tg—45 to 58 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; moderate fine blocky structure; extremely hard, very firm; few fine roots; few thin clay films on ped faces; few concretions of calcium carbonate; moderately alkaline; calcareous; gradual wavy boundary.
Cca—58 to 60 inches; light brownish gray (10YR 6/2) clay, grayish brown (10YR 5/2) moist; massive; few fine roots; common concretions of calcium carbonate; moderately alkaline; calcareous.

Solum thickness ranges from 40 to 72 inches. The depth to concretions of calcium carbonate ranges from 30 to 50 inches.

The A1 or Ap horizon is grayish brown, brown, dark grayish brown, or very dark grayish brown. Reaction is slightly acid or neutral. The soil is massive and hard or very hard when dry. The A2g horizon is light gray or very pale brown.

The B2t horizon is very dark grayish brown, very dark gray, dark grayish brown, gray, dark gray, or grayish brown. Reaction ranges from neutral to moderately alkaline. This horizon is calcareous in the lower part.

The Cca horizon is light brownish gray or very pale brown clay.

Hensley series

The Hensley series consists of shallow, well drained soils that formed over thick beds of limestone on uplands. Slopes range from 0 to 5 percent.

Typical pedon of Hensley very stony clay loam, 0 to 5 percent slopes; from the intersection of U. S. Highway 281 and U. S. Highway 180 in Mineral Wells, 9.5 miles west on U. S. Highway 180, and 50 feet north of road right-of-way fence in rangeland:

A1—0 to 6 inches; reddish brown (5YR 5/4) very stony clay loam, reddish brown (5YR 4/4) moist; weak medium subangular blocky structure; hard, friable; many fine roots; limestone fragments, 6 to 40 inches in diameter, cover about 10 percent of the surface; neutral; clear smooth boundary.
B21t—6 to 15 inches; dark reddish brown (2.5YR 3/4) clay loam, dark reddish brown (2.5YR 3/4) moist; moderate medium subangular blocky structure; extremely hard, very firm; common fine roots; few fine pores; thin discontinuous clay films on faces of peds; neutral; abrupt smooth boundary.
R—15 to 18 inches; limestone bedrock.

Solum thickness and depth to bedrock range from 10 to 20 inches. From none to 40 percent of the surface is covered with limestone gravel and fragments.

The A1 horizon is 4 to 10 inches thick. The content of limestone fragments and gravel ranges from none to 25 percent, by volume. This horizon is reddish brown or brown. Reaction ranges from slightly acid to mildly alkaline.

The B2 horizon is reddish brown, dark reddish brown, or red. Texture is clay or clay loam. In some pedons, this

horizon has as much as 15 percent coarse limestone fragments. Reaction ranges from neutral to moderately alkaline.

Leeray series

The Leeray series consists of deep, well drained soils that have gilgai microrelief and high shrink-swell potential. These soils formed in calcareous clay on uplands. Slopes range from 0 to 5 percent.

Typical pedon of Leeray clay, 1 to 3 percent slopes; from the junction of State Highway 254 and Farm Road 206 in the town of Graford, and 0.8 mile south on paved county road. The site is 75 feet west of the point at which two county roads intersect:

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure and moderate medium subangular blocky; extremely hard, very firm; many fine roots; few concretions of calcium carbonate; moderately alkaline; calcareous; abrupt smooth boundary.

A12—8 to 32 inches; very dark grayish brown (10YR 3/2) clay, very dark brown (10YR 2/2) moist; moderate medium subangular blocky structure; extremely hard, very firm; few fine roots; common concretions of calcium carbonate; common intersecting slickensides that increase with depth; moderately alkaline; calcareous; gradual wavy boundary.

AC—32 to 50 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; moderate medium subangular blocky structure; extremely hard, very firm; few fine roots; common concretions of calcium carbonate; common intersecting slickensides; moderately alkaline; calcareous; gradual wavy boundary.

Cca—50 to 60 inches; light olive brown (2.5Y 5/4) clay, olive brown (2.5Y 4/4) moist; massive; prominent grooved slickensides; very hard, very firm; common films and threads of calcium carbonate; moderately alkaline; calcareous.

The thickness of the A and AC horizons ranges from 40 to more than 80 inches. When dry, these soils have cracks as much as 1 inch wide that extend from the surface to depths of more than 20 inches. Cycles of microknolls and microdepressions are repeated at 8- to 23-foot intervals. The A horizon is thicker in microdepressions and thinner on microknolls.

The A1 horizon is very dark grayish brown, grayish brown, dark grayish brown, brown, or dark brown.

The AC horizon is grayish brown, dark grayish brown, dark brown, pale brown, brown, dark yellowish brown, olive brown, or light olive brown. Concretions of calcium carbonate are few to common.

The Ca horizon is in shades of olive, yellow, and gray. Texture is shale, shaly clay, or clay.

Lindy series

The Lindy series consists of moderately deep, well drained soils that formed over thick beds of limestone on uplands. Slopes range from 1 to 3 percent

Typical pedon of Lindy clay loam, 1 to 3 percent slopes; from the junction of Farm Road 4 and Texas Highway 254 west of the town Graford, 1.4 miles south on Farm Road 4, 1.4 miles south on county road, 1.25 miles west on county road, and 600 feet south:

A1—0 to 8 inches; brown (7.5YR 5/4) clay loam, dark brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; hard, friable; common fine roots and pores; slightly acid; clear smooth boundary.

B21t—8 to 24 inches; reddish brown (2.5YR 4/4) clay loam, dark reddish brown (2.5YR 3/4) moist; moderate medium subangular blocky structure; very hard, firm; few fine roots and pores; continuous clay films on ped surfaces; mildly alkaline; gradual wavy boundary.

B22t—24 to 30 inches; reddish brown (5YR 4/4) clay loam, dark reddish brown (5YR 3/4) moist; weak medium subangular blocky structure; hard, firm; few fine roots and pores; continuous clay films on ped surfaces; mildly alkaline; abrupt smooth boundary.

R—30 to 40 inches; hard limestone with a few fractures.

Solum thickness and depth to limestone bedrock is 20 to 40 inches. Reaction ranges from slightly acid to mildly alkaline.

The A1 horizon is brown, reddish brown, or dark brown. The Bt horizon is reddish brown, dark reddish brown, brown, red, or yellowish red. Texture is clay loam or clay. The clay content is 35 to 50 percent.

May series

The May series consists of deep, well drained soils that formed in loamy calcareous, alluvial sediment on uplands. Slopes are 0 to 1 percent.

Typical pedon of May very fine sandy loam, 0 to 1 percent slopes; from a railroad crossing in the town of Brazos, 5.1 miles west and 100 feet south of road right-of-way fence:

Ap—0 to 8 inches; pale brown (10YR 6/3) very fine sandy loam, brown (10YR 5/3) moist; weak fine subangular blocky structure; slightly hard, very friable; common medium roots; neutral; abrupt smooth boundary.

A12—8 to 18 inches; grayish brown (10YR 5/2) very fine sandy loam, dark grayish brown (10YR 4/2) moist; weak fine subangular blocky structure; slightly hard, very friable; common medium roots; neutral; gradual smooth boundary.

B21t—18 to 36 inches; yellowish brown (10YR 5/4) sandy clay loam, dark yellowish brown (10YR 4/4)

moist; moderate medium subangular blocky structure; hard, friable; few fine roots; common fine pores; common clay films on ped faces; mildly alkaline; gradual smooth boundary.

B22t—36 to 48 inches; light yellowish brown (10YR 6/4) sandy clay loam, yellowish brown (10YR 5/4) moist; weak medium subangular blocky structure; hard, friable; few fine roots; common fine pores; few clay films on ped faces; mildly alkaline; gradual smooth boundary.

B3—48 to 60 inches; very pale brown (10YR 7/4) fine sandy loam, light yellowish brown (10YR 6/4) moist; weak medium subangular blocky structure; hard, friable; few fine roots; few soft masses of calcium carbonate; calcareous; moderately alkaline.

Solum thickness is 40 to 70 inches. Depth to films, threads, and soft masses of calcium carbonate ranges from 36 to 62 inches.

The A horizon is brown, pale brown, grayish brown, dark grayish brown, light brownish gray, dark yellowish brown, or yellowish brown. Organic matter is less than 1 percent. Reaction ranges from slightly acid to mildly alkaline.

The Bt horizon is brown, dark grayish brown, yellowish brown, or light yellowish brown. Some pedons have faint reddish or yellowish mottles in the lower part. The B21t and B22t horizons are sandy clay loam or clay loam with clay content ranging from 20 to 35 percent. Reaction is neutral or mildly alkaline.

The B3 horizon is in shades of brown. Texture is sandy clay loam, loam, or fine sandy loam.

Minwells series

The Minwells series consists of deep, well drained soils that formed in ancient loamy sediment on high stream terraces of the Brazos River and other major streams. Slopes range from 1 to 5 percent.

Typical pedon of Minwells fine sandy loam, 1 to 3 percent slopes; from the junction of U. S. Highway 281 and U. S. Highway 180 in Mineral Wells, 4.7 miles west on U. S. Highway 180 to the Brazos River bridge, 0.7 mile west on U. S. Highway 180, and 600 feet south in pasture to south face of gravel pit:

Ap—0 to 6 inches; light reddish brown (5YR 6/4) fine sandy loam, reddish brown (5YR 5/4) moist; weak fine subangular blocky structure; hard, friable; many fine roots; few medium rounded siliceous pebbles; mildly alkaline; abrupt smooth boundary.

B21t—6 to 17 inches; reddish brown (2.5YR 4/4) clay, dark reddish brown (2.5YR 3/4) moist, moderate coarse prismatic structure parting to strong medium and coarse blocky; very hard, firm; common fine roots; few fine pores; continuous thin clay films on faces of prisms; few medium rounded siliceous pebbles and few medium angular sandstone pebbles; slightly acid; gradual wavy boundary.

B22t—17 to 31 inches; red (2.5YR 4/6) clay loam, dark red (2.5YR 3/6) moist in interior of peds, dark reddish brown (2.5YR 3/4) coatings on the faces of peds; moderate coarse prismatic structure parting to strong coarse blocky; very hard, firm; common fine roots and few medium roots that are concentrated mainly on the faces of prisms; few fine pores; common rounded and angular siliceous pebbles and fragments of chert as much as 20 millimeters in diameter; slightly acid; gradual wavy boundary.

B23t—31 to 46 inches; red (2.5YR 5/6) clay loam, red (2.5YR 4/6) moist in interiors of peds, dark reddish brown (2.5YR 3/4) coatings on the faces of peds; weak coarse prismatic structure parting to moderate medium and coarse subangular blocky; hard, firm; few fine roots that are mainly on the faces of prisms; few fine pores; few rounded and angular siliceous pebbles and few fragments of sandstone as much as 20 millimeters; neutral; gradual wavy boundary.

B31ca—46 to 57 inches; yellowish red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist, in interiors of peds, red (2.5YR 4/6) coatings on exteriors of the peds; weak fine subangular blocky structure; hard, firm; few fine roots on the faces of prisms; few medium and coarse pores, common fine pores; few medium rounded siliceous pebbles; common threads, films, and soft masses of calcium carbonate on faces of prisms; calcareous; moderately alkaline; clear wavy boundary.

B32ca—57 to 71 inches; yellowish red (5YR 5/6) gravelly sandy clay loam, yellowish red (5YR 4/6) moist; weak fine subangular blocky structure; hard, firm; few fine roots; few fine tubes and pores; the upper part contains an estimated 30 percent rounded siliceous pebbles and angular sandstone, limestone, and chert fragments as much as 1 inch in diameter; the lower part contains approximately 50 percent, by volume, pebbles; moderately alkaline; calcareous; gradual wavy boundary.

IICca—71 to 80 inches; red (2.5YR 5/8) very gravelly sand, red (2.5YR 4/8) moist; massive; hard, friable; few fine roots in upper part; estimated 60 percent rounded siliceous pebbles and angular limestone and chert fragments from 2 millimeters to 4 inches in diameter; the underside of the larger coarse fragments contains pendants and coatings of calcium carbonate; lower 3 inches of the horizon is partially cemented together with calcium carbonate; moderately alkaline; calcareous.

Solum thickness and depth to beds of gravel range from 40 to about 80 inches. The A horizon is light reddish brown, reddish brown, light brown, or brown. Siliceous pebbles make up 0 to 10 percent, by volume. Reaction ranges from slightly acid to mildly alkaline.

The B21t and B22t horizons are reddish brown, red, yellowish red, or reddish brown. Texture is clay, clay

loam, or sandy clay. Clay content ranges from 35 to 50 percent. Pebbles of quartz and sandstone range from 0 to 10 percent, by volume. Reaction is slightly acid or neutral.

The B23t and B31ca horizons are reddish brown, red, yellowish red, or reddish brown. Texture is clay loam, sandy clay loam, or gravelly sandy clay loam. Pebbles of quartz, sandstone, or limestone range from a few to 20 percent, by volume. Reaction ranges from neutral to moderately alkaline.

The B32ca and IICca horizons are red, yellowish red, or reddish yellow. Texture is gravelly sandy clay loam, very gravelly sandy clay loam, very gravelly sandy loam, or very gravelly sand. Pebbles of quartz, limestone, or sandstone range from 25 to 80 percent, by volume. Reaction is mildly alkaline or moderately alkaline.

Owens series

The Owens series consists of shallow, well drained soils that formed in clayey material weathered from shale on uplands. Slopes range from 1 to 40 percent.

Typical pedon of Owens very stony clay, 8 to 40 percent slopes; from the intersection of Interstate Highway 20 and Farm Road 919, south of the town of Gordon, 0.5 mile north on Farm Road 919, and 600 feet east on side of a hill:

A1—0 to 4 inches; brown (10YR 5/3) very stony clay, brown (10YR 4/3) moist; weak fine angular blocky and granular structure; very hard, very firm; crust on surface when dry; common fine roots; limestone fragments, 6 to 30 inches in diameter, cover 3 to 15 percent of the surface; calcareous; moderately alkaline; clear smooth boundary.

B2ca—4 to 16 inches; light olive brown (2.5Y 5/4) clay, olive brown (2.5Y 4/4) moist; moderate medium angular blocky structure; extremely hard, very firm; common fine roots; few medium soft masses of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

Cr—16 to 40 inches; pale olive (5Y 6/4) shaly clay, olive (5Y 5/4) moist; massive; extremely hard, extremely firm; few fine roots in crevices in upper 3 inches; calcareous; moderately alkaline.

Thickness of the combined A and B2ca horizons is 10 to 20 inches.

The A horizon is olive, pale olive, olive brown, light olive brown, light yellowish brown, brown, grayish brown, or light brownish gray. Texture is clay or very stony clay. Clay content ranges from 40 to 50 percent. In some areas, fragments of limestone, sandstone, and ironstone, ranging from 3 to 40 inches in diameter, cover as much as 20 percent of the surface. Some areas do not have fragments on the surface.

The B2ca horizon is olive, pale olive, olive brown, light olive brown, grayish brown, light brownish gray, pale brown, brown, yellowish brown, or light yellowish brown. Texture is clay or shaly clay.

The Cr horizon is olive to reddish shaly clay, very shaly clay, or shale.

Palopinto series

The Palopinto series consists of shallow and very shallow, well drained stony soils that formed in material weathered from Pennsylvanian limestone. These soils are on undulating upland ridges. Slopes are dominantly about 2 percent but range from 1 to 40 percent.

Typical pedon of Palopinto extremely stony clay loam, 1 to 8 percent slopes; from the intersection of U. S. Highways 180 and 281 in the town of Mineral Wells, 8 miles north on U. S. Highway 281, 3.6 miles west and north on Texas Highway 254, and 1,600 feet east in rangeland:

A11—0 to 4 inches; dark grayish brown (10YR 4/2) extremely stony clay loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure and moderate fine granular; hard, friable; many fine roots; many fine pores; few worm casts; about 30 percent, by volume, fragments of limestone from 6 to 30 inches in diameter and 5 percent, by volume, fragments less than 3 inches in diameter; moderately alkaline; clear smooth boundary.

A12—4 to 12 inches; dark grayish brown (10YR 4/2) extremely stony clay loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure and moderate fine granular; hard, friable; common fine roots; common fine pores; few worm casts; about 70 percent, by volume, fragments of limestone that are 6 to 30 inches in diameter; moderately alkaline; abrupt wavy boundary.

R—12 to 14 inches; indurated limestone; coarsely fractured; less than 5 percent of volume is fine-earth in fractures and crevices.

Solum thickness ranges from 6 to 20 inches to indurated limestone. The solum contains 35 to 85 percent coarse fragments of limestone, the amount ranging from 15 to 60 percent in the A11 horizon and from 50 to 90 percent in the A12 horizon. The coarse fragments are flat limestone fragments that range from 0.5 inch to 36 inches across the long axis, but they are dominantly 6 to 20 inches across. Reaction ranges from neutral to moderately alkaline. The soil typically is noncalcareous. The A horizon is dark grayish brown, dark brown, or very dark grayish brown.

Patilo series

The Patilo series consists of deep, moderately well drained soils that formed in thick sandy beds of eolian origin on uplands. Slopes range from 1 to 3 percent.

Typical pedon of Patilo fine sand, 1 to 3 percent slopes; from the intersection of U.S. Highway 281 and

Texas Highway 4 in the southeastern part of the county, 3 miles east on Texas Highway 4, 1.8 miles north on a country road, and 400 feet west:

A1—0 to 6 inches; pale brown (10YR 6/3) fine sand, brown (10YR 5/3) moist; single grain; loose, moist and dry; few fine roots; medium acid; clear wavy boundary.
A2—6 to 45 inches; light gray (10YR 7/2) fine sand, light brownish gray (10YR 6/2) moist; single grain; loose, moist and dry; few fine roots; medium acid; abrupt wavy boundary.
B21t—45 to 65 inches; strong brown (7.5YR 5/6) sandy clay loam, strong brown (7.5YR 5/6) moist, common coarse distinct mottles of light brownish gray (10YR 6/2); moderate medium subangular blocky structure; hard, firm; few fine roots; few fine pores; thin patchy clay films on ped faces; medium acid.

Solum thickness ranges from 65 to more than 100 inches. The A horizon ranges from 40 to 80 inches thick. Reaction ranges from medium acid to neutral. The A1 horizon is dark grayish brown, dark brown, grayish brown, brown, light brownish gray, pale brown, very pale brown, light yellowish brown, yellowish brown, or dark yellowish brown.

The A2 horizon is brown, very pale brown, light gray, white, light yellowish brown, or reddish yellow. The boundary between the A2 and B2t horizons is wavy to irregular.

Clay content of the B2 horizon is dominantly 25 to 35 percent but ranges from 18 to 35 percent. Reaction ranges from strongly acid to slightly acid. Base saturation throughout the argillic horizon ranges from 40 to 75 percent. The B2t horizon is light gray, brown, light brownish gray, strong brown, white, very pale brown, pale brown, light yellowish brown, brownish yellow, reddish yellow, yellowish red, yellowish brown, or yellow with varied sizes and amounts of red, yellow, and gray mottles.

Santo series

The Santo series consists of deep, well drained soils that formed in loamy calcareous, stratified alluvial sediment on bottom lands. Slopes range from 0 to 3 percent.

Typical pedon of Santo fine sandy loam, frequently flooded; from the junction of Farm Road 4 and Farm Road 129 in Santo, 3.9 miles northeast on Farm Road 129, 0.7 mile south on private road through pasture; site is in bermudagrass pasture, 100 feet from the bank of Palo Pinto Creek:

A1—0 to 8 inches; light yellowish brown (10YR 6/4) fine sandy loam, yellowish brown (10YR 5/4) moist; weak fine subangular blocky structure; slightly hard, very friable; many fine roots; many fine pores; calcareous; moderately alkaline; abrupt smooth boundary.
C1—8 to 12 inches; brown (10YR 4/3) loam, dark brown (10YR 3/3) moist; massive; slightly hard, very friable; many fine roots; many fine pores; calcareous; moderately alkaline; abrupt smooth boundary.
C2—12 to 36 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) moist; massive; prominent bedding planes; slightly hard, very friable; common fine roots; many fine pores; calcareous; moderately alkaline; abrupt smooth boundary.
C3—36 to 44 inches; very pale brown (10YR 7/4) loamy fine sand, yellowish brown (10YR 5/4) moist; massive; loose, moist and dry; few fine roots; prominent bedding planes; calcareous; moderately alkaline; abrupt smooth boundary.
C4—44 to 70 inches; light yellowish brown (10YR 6/4) fine sandy loam, yellowish brown (10YR 5/4) moist; massive; slightly hard, very friable; common thin strata of loamy fine sand; calcareous; moderately alkaline; abrupt smooth boundary.
C5—70 to 80 inches; brown (10YR 4/3) fine sandy loam; dark brown (10YR 3/3) moist; massive; slightly hard, very friable; thin strata of loamy fine sand; calcareous; moderately alkaline.

Texture of the 10- to 40-inch control section is stratified fine sandy loam, loamy fine sand, or loam with thin strata of sandy clay loam or silt loam. Clay content of the control section is 5 to 18 percent, and more than 15 percent is coarser than very fine sand.

The A1 horizon ranges from 4 to 15 inches in thickness. It is light yellowish brown, very pale brown, brown, pale brown, brownish yellow, strong brown, or light brown. Reaction is mildly alkaline or moderately alkaline, and the soil is calcareous.

The C horizon is brown, yellowish brown, pale brown, very pale brown, light yellowish brown. Texture is loam, fine sandy loam, or loamy fine sand. Noncalcareous strata are common.

Set series

The Set series consists of deep, well drained soils that formed in clayey and shaly sediments on uplands. Slopes range from 1 to 40 percent.

Typical pedon of Set extremely stony clay, in an area of Set-Palopinto complex, extremely stony, 8 to 40 percent slopes; from the intersection of Texas Highway 16 and Texas Highway 108 in the town of Strawn, 0.9 mile north on Texas Highway 16, 5.1 miles west on Farm Road 207, 1.2 miles north on county road, and 15 feet east of road in rangeland:

A1—0 to 12 inches; dark grayish brown (10YR 4/2) extremely stony clay, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; hard,

firm; many fine and few medium roots; about 25 percent of surface covered by fragments of limestone dominantly 10 to 36 inches in diameter and 3 to 8 inches thick; about 2 percent, by volume, fragments of limestone 0.1 inch to 2 inches in diameter; calcareous; moderately alkaline; clear smooth boundary.

B21ca—12 to 26 inches; brown (10YR 5/3) clay, dark brown (10YR 4/3) moist; moderate fine and very fine subangular blocky structure; hard, firm; common fine and few medium roots; common fine pores; about 3 percent of volume is concretions and soft masses of calcium carbonate, about 20 percent is limestone fragments less than 0.5 inch in diameter, and about 2 percent is limestone fragments 1 inch to 8 inches in diameter; calcareous; moderately alkaline; gradual smooth boundary.

B22ca—26 to 38 inches; yellowish brown (10YR 5/4) silty clay, dark yellowish brown (10YR 4/4) moist; moderate fine and very fine subangular blocky structure; very hard, firm; common fine and few medium roots; few fine pores; many concretions and soft masses of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

B3ca—38 to 44 inches; light yellowish brown (10YR 6/4) silty clay loam, yellowish brown (10YR 5/4) moist; moderate fine and medium subangular blocky structure; very hard, firm; few fine and medium roots; few fine pores; many concretions and soft masses of calcium carbonate; calcareous; moderately alkaline; gradual wavy boundary.

C—44 to 60 inches; light brownish gray (10YR 6/2) shaly clay, grayish brown (10YR 5/2) moist; common streaks and mottles of light yellowish brown (10YR 6/4) and gray (10YR 6/1); material parts readily to medium angular fragments; few fine and medium roots; few concretions of calcium carbonate; calcareous; moderately alkaline.

Solum thickness ranges from 40 to 60 inches. The mollic epipedon is 10 to 19 inches thick. In some areas, fragments of limestone, 10 to 36 inches in diameter, cover as much as 40 percent of the surface. Some areas do not have fragments on the surface.

The A horizon is brown, very dark grayish brown, grayish brown, or dark grayish brown. Texture is clay or extremely stony clay.

The Bca horizon is pale brown, light brownish gray, brown, light yellowish brown, yellowish brown, olive gray, and olive silty clay loam, silty clay, or clay. It contains from 10 to 35 percent fine limestone fragments and contains concretions and soft masses of calcium carbonate.

The C horizon is pale olive, light olive brown, olive, light olive gray, very pale brown, light brownish gray, gray, or light yellowish brown. Texture is shaly clay or shaly clay interbedded with clayey and loamy materials. A few fragments of limestone, 8 to 24 inches in diameter are throughout the soil in some pedons.

Shatruce series

The Shatruce series consists of deep, well drained soils that formed in material weathered from shale on uplands. These soils are on hillsides and escarpments along drainageways. Slopes range from 8 to 40 percent.

Typical pedon of Shatruce very bouldery sandy loam, 8 to 40 percent slopes; from the intersection of U.S. Highway 281 and Farm Road 2256, on the south edge of the city of Mineral Wells, 5.6 miles south on U.S. Highway 281, and 45 feet west in rangeland:

A1—0 to 2 inches; dark grayish brown (10YR 4/2) very bouldery sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable; many fine and few medium roots; conglomerate boulders 2 to 20 feet in diameter that are cemented with silica and iron oxide cover about 15 percent of the surface, and stones 8 to 24 inches in diameter cover about 45 percent of surface; siliceous and sandstone pebbles and fragments of conglomerate less than 3 inches in diameter comprise about 27 percent, by volume; neutral; clear smooth boundary.

A2—2 to 14 inches; very pale brown (10YR 8/3) sandy loam, very pale brown (10YR 7/3) moist; weak fine subangular blocky structure; hard, friable; common fine and few medium roots; siliceous and sandstone pebbles less than 2 inches in diameter comprise about 27 percent, by volume; slightly acid; abrupt smooth boundary.

B21t—14 to 20 inches; red (2.5YR 4/6) clay, dark red (2.5YR 3/6) moist; moderate medium blocky structure; extremely hard, very firm; few fine and medium roots; common clay films on faces of peds; very strongly acid; gradual wavy boundary.

B22t—20 to 26 inches; yellowish red (5YR 5/6) clay, yellowish red (5YR 4/6) moist; few fine faint brown and yellowish brown mottles; moderate medium blocky structure; extremely hard, very firm; few fine and medium roots; few clay films on faces of peds; very strongly acid; gradual wavy boundary.

B3—26 to 34 inches; reddish yellow (7.5YR 6/6) sandy clay, strong brown (7.5YR 5/6) moist; few fine faint reddish and brownish mottles; weak coarse blocky structure; extremely hard, very firm; few fine and medium roots; few clay films on faces of peds; very strongly acid; gradual wavy boundary.

C—34 to 60 inches; grayish brown (2.5Y 5/2) shaly clay, dark grayish brown (2.5Y 4/2) moist; common discontinuous strata 1/4 inch to 4 inches thick of light yellowish brown (10YR 6/4) clay loam; few pockets, 2 to 6 inches in diameter, of very dusky red (2.5YR 2/2) shaly clay; material parts to medium angular fragments; few fine and medium roots; strongly acid.

Solum thickness ranges from 20 to 40 inches. Boulders and stones cover 25 to 70 percent of the

surface. Boulders cover 3 to 20 percent of the surface, and stones cover 25 to 50 percent. The boulders and stones range from 8 inches to 25 feet across the long axis and from 4 inches to about 8 feet thick. They are conglomerates or sandstone that is cemented with silica and iron oxide.

The A horizon ranges from 8 to 20 inches thick. The A1 horizon is brown, pale brown, yellowish brown, or dark grayish brown. The A2 horizon is very pale brown, pale brown, light yellowish brown, brown, or yellowish brown. Reaction ranges from medium acid to neutral. Siliceous and sandstone pebbles and fragments of conglomerate less than 3 inches across the long axis comprise 5 to 35 percent of the A horizon.

Texture of the B horizon is clay, sandy clay, or clay loam. Clay content ranges from 35 to about 50 percent. Stones and fragments comprise 0 to 5 percent. The B2t horizon is reddish brown or dark reddish brown, red, or yellowish red. Reaction ranges from very strongly acid to medium acid.

The B3 horizon ranges from reddish yellow to light olive brown in hue of 7.5YR, 10YR, and 2.5Y. In some pedons, there are faint red or brown mottles. Reaction ranges from strongly acid to slightly acid.

Texture of the C horizon is shaly clay, clay, or shaly clay with stratified loamy material. This horizon is in shades of brown, red, and olive. Reaction ranges from very strongly acid to slightly acid. Stones and fragments comprise 0 to 5 percent.

Shavash series

The Shavash series consists of shallow, well drained, stony soils that formed on uplands in material weathered from sandstone of Pennsylvanian age. These soils are on broad, gently sloping ridgetops. Slopes range from 1 to 3 percent.

Typical pedon of Shavash stony loamy fine sand, 1 to 3 percent slopes; from the intersection of Farm Road 4 and 129 in the town of Santo, 4.2 miles north on Farm Road 5 to paved road, 0.5 mile west on paved road to north end of Palo Pinto Lake dam, 0.6 mile west, and 60 feet north in rangeland:

A1—0 to 4 inches; brown (10YR 4/3) stony loamy fine sand, dark brown (10YR 3/3) moist; weak fine granular structure; hard, friable; many fine roots; fragments of sandstone, 10 to 36 inches in diameter, cover about 3 percent of the surface; slightly acid; clear smooth boundary.

A2—4 to 10 inches; light brown (7.5YR 6/4) loamy fine sand, brown (7.5YR 5/4) moist; single grain; slightly hard, friable; few fine roots; few fine fragments of chert and sandstone; slightly acid; clear smooth boundary.

B2t—10 to 16 inches; brownish yellow (10YR 6/6) sandy clay loam, yellowish brown (10YR 5/6) moist, common medium distinct yellowish red and yellow mottles; moderate fine subangular blocky structure; very hard, firm; few fine roots; many medium pores; few fine fragments of chert; few thin clay films on faces of peds; slightly acid; abrupt smooth boundary.

R—16 to 18 inches; very strongly cemented brown sandstone.

Solum thickness and depth to very strongly cemented or indurated sandstone range from 10 to 20 inches. Coarse fragments of sandstone and chert in the solum range from 0 to 15 percent, by volume. Some pedons have fragments of sandstone ranging from 10 to 36 inches in diameter that are generally imbedded in the A horizon. The stones cover 2 to 10 percent of the surface.

The A1 horizon is brown, pale brown, dark brown, yellowish brown, grayish brown, or dark grayish brown. In most pedons, the A2 horizon is 1 unit or 2 units of value or chroma higher than the A1 horizon. Reaction is neutral or slightly acid.

The Bt horizon is yellowish brown, brownish yellow, yellow, brown, strong brown, or light yellowish brown with reddish and yellowish mottles. This horizon is sandy clay loam or clay loam with clay content of 20 to 35 percent. Reaction is medium acid or slightly acid. Base saturation ranges from 50 to 75 percent.

Thurber series

The Thurber series consists of deep, moderately well drained soils that formed in calcareous clayey outwash or ancient alluvial sediment in upland valleys. Slopes range from 0 to 3 percent.

Typical pedon of Thurber clay loam, 1 to 3 percent slopes; from the railroad crossing in the town of Gordon, 1.3 miles north on Farm Road 919, 0.9 mile east on Farm Road 2692, and 50 feet south of road right-of-way:

Ap—0 to 8 inches; grayish brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; massive; very hard, firm; few fine roots; mildly alkaline; clear smooth boundary.

B21t—8 to 26 inches; very dark grayish brown (10YR 3/2) clay, very dark brown (10YR 2/2) moist; moderate medium blocky structure; extremely hard, very firm; few fine roots; continuous clay films on faces of peds; mildly alkaline; gradual wavy boundary.

B22t—26 to 36 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate medium blocky structure; extremely hard, very firm; few fine roots; continuous clay films on faces of peds; few fine concretions, soft bodies and films of calcium carbonate; moderately alkaline; calcareous; gradual wavy boundary.

Cca—36 to 72 inches; light brownish gray (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/2) moist; massive; common medium distinct mottles of olive yellow

(2.5Y 6/6); common threads and soft masses of calcium carbonate; moderately alkaline; calcareous.

Solum thickness ranges from 30 to 60 inches. Depth to films, threads, concretions, or soft masses of calcium carbonate ranges from 15 to 28 inches.

The A horizon is grayish brown, brown, or dark grayish brown. Reaction ranges from slightly acid to mildly alkaline. The A horizon is hard and massive when the soil is dry, and thickness ranges from 6 to 12 inches.

The Bt horizon is dark grayish brown, very dark grayish brown, brown, dark brown, yellowish brown, or grayish brown. Texture is clay or clay loam. Reaction ranges from neutral to moderately alkaline.

The Cca and C horizons range from brownish and grayish calcareous clay loam to olive gray shaly clay.

Truce series

The Truce series consists of deep, well drained soils that formed in material weathered from shale interbedded with sandstone strata on uplands. Slopes range from 1 to 40 percent.

Typical pedon of Truce fine sandy loam, 1 to 3 percent slopes; from the intersection of Interstate Highway 20 and Farm Road 919, south of the town of Gordon, 0.4 mile east on north access road of Interstate Highway 20, and 90 feet north in rangeland:

A1—0 to 6 inches; brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 4/4) moist; weak fine subangular blocky structure; very hard, friable; common fine roots; slightly acid; abrupt smooth boundary.

A2—6 to 7 inches; pink (7.5YR 7/4) fine sandy loam, light brown (7.5YR 6/4) moist; massive; very hard, friable; common fine roots; slightly acid; abrupt smooth boundary.

B21—7 to 28 inches; yellowish red (5YR 5/6) clay, yellowish red (5YR 4/6) moist; moderate medium blocky structure; extremely hard, very firm; few fine roots; common clay films on faces of peds; neutral; gradual smooth boundary.

B22t—28 to 40 inches; brown (7.5YR 5/4) clay, brown (7.5YR 4/4) moist; moderate medium blocky structure; extremely hard, very firm; few fine roots; common clay films on faces of peds; neutral; gradual smooth boundary.

B3—40 to 48 inches; brownish yellow (10YR 6/6) clay, yellowish brown (10YR 5/6) moist; weak medium blocky structure; extremely hard, very firm; neutral; gradual smooth boundary.

C—48 to 60 inches; pale yellow (2.5Y 7/4) shaly clay, light yellowish brown (2.5Y 6/4) moist; massive; interbedded with olive shaly clay and thin soft sandstone strata; moderately alkaline.

Solum thickness ranges from 40 to 60 inches. Sandstone fragments ranging from 2 millimeters to about 18 inches in diameter make up from 0 to 25 percent, by volume, of the A horizon. Reaction ranges from medium acid to neutral. The A1 horizon is brown, pale brown, yellowish brown, or dark grayish brown. The A2 horizon is 1 or 2 units of value higher than the A1 horizon.

Texture of the B horizon is clay, sandy clay, or clay loam. Clay content ranges from 35 to about 50 percent.

The B21t horizon is reddish brown or dark reddish brown, red, or yellowish red. Reaction ranges from slightly acid to mildly alkaline.

The B22t horizon is brown, strong brown, yellowish red, yellowish brown, reddish yellow, or reddish brown. Reaction ranges from neutral to moderately alkaline.

The B3 horizon ranges from yellowish brown to light olive brown and has hue of 10YR and 2.5Y. In some pedons, the B3 horizon has faint reddish or olive mottles; in others it is free of mottles. Reaction ranges from neutral to moderately alkaline.

Texture of the C horizon is clayey shale, partially weathered shale, or brittle shaly clay with discontinuous layers of sandstone. This horizon is pale yellow, olive, pale olive, olive yellow, light yellowish brown, brownish yellow, light brown, light gray, gray, and light olive brown and has hue of 10YR through 5Y. Reaction ranges from neutral to moderately alkaline.

Vashti series

The Vashti series consists of moderately deep, moderately well drained soils that formed in material weathered from sandstone on uplands. Slopes range from 1 to 5 percent.

Typical pedon of Vashti loamy fine sand, 1 to 5 percent slopes; from the junction of Farm Roads 4 and 129 in the town of Santo, 4.2 miles north on Farm Road 4 to intersection of Farm Road 4 and unnumbered paved road, 0.5 mile west on paved road to north end of Palo Pinto Lake dam, 0.6 mile west, and 500 feet northwest in rangeland:

A1—0 to 4 inches; dark grayish brown (10YR 4/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; single grain; hard, friable; loose; few fine roots; slightly acid; clear smooth boundary.

A2—4 to 16 inches; brown (10YR 5/3) loamy fine sand, brown (10YR 4/3) moist; single grain; hard, friable; few fine roots; slightly acid; clear smooth boundary.

B21t—16 to 24 inches; yellowish brown (10YR 5/4) sandy clay loam, dark yellowish brown (10YR 4/4) moist, with few fine distinct grayish brown and red mottles; weak medium subangular blocky structure; hard, firm; few fine roots; common fine pores; common thin clay films on faces of peds; slightly acid; clear wavy boundary.

B22t—24 to 34 inches; brownish yellow (10YR 6/6) sandy clay loam, yellowish brown (10YR 5/6) moist, common fine distinct mottles of grayish brown and red; weak medium subangular blocky structure; hard,

firm; few fine roots; common fine pores; common thin clay films on faces of peds; slightly acid; abrupt wavy boundary.
R—34 to 36 inches; reddish yellow sandstone bedrock.

The A horizon ranges from 5 to 18 inches in thickness. The A1 horizon is light brown, dark brown, brown, dark grayish brown, or pale brown.

The A2 horizon is lighter in color than the A1 horizon and is present in rangeland. The A1 and A2 horizons have been mixed in most cultivated areas. Reaction in the A horizon is slightly acid or neutral.

The B2t horizon ranges from 12 to 35 inches in thickness. It is reddish yellow, yellow, yellowish brown, strong brown, or brownish yellow and has common light gray or grayish brown mottles. Texture is clay loam or sandy clay loam. Reaction ranges from medium acid to neutral.

The R layer is strongly cemented sandstone bedrock. It is at a depth of 20 to 40 inches.

Velow series

The Velow series consists of deep, well drained soils that formed in loamy material weathered from limestone on uplands. These gently sloping soils are on foot slopes and in narrow valleys. Slopes are 1 to 5 percent.

Typical pedon of Velow clay loam, 3 to 5 percent slopes; from the intersection of Texas Highway 16 and Farm Road 2372 in the town of Strawn, 1.4 miles west on Farm Road 2372, and 50 feet north in rangeland:

A1—0 to 16 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky and granular structure; hard, friable; common fine roots; common fine pores; few worm casts; mildly alkaline; gradual wavy boundary.
B21—16 to 30 inches; yellowish brown (10YR 5/4) clay loam, dark yellowish brown (10YR 4/4) moist; moderate medium subangular blocky structure; hard, friable; few fine roots; common fine pores; moderately alkaline; clear smooth boundary.
B22ca—30 to 45 inches; light yellowish brown (10YR 6/4) clay loam, yellowish brown (10YR 5/4) moist; moderate medium subangular blocky structure; few fine roots; common fine pores; common films and threads of calcium carbonate; moderately alkaline; clear smooth boundary.
B3ca—45 to 60 inches; yellowish brown (10YR 5/4) clay loam, dark yellowish brown (10YR 4/4) moist; weak medium subangular blocky structure; hard, friable; few fine roots; common fine pores; common films, threads, and soft masses of calcium carbonate; few limestone fragments less than 1 inch in diameter; moderately alkaline; calcareous.

Solum thickness ranges from 40 to 70 inches. Organic matter content decreases regularly with depth.

The A horizon is dark grayish brown, dark brown, grayish brown, or very dark grayish brown. Reaction ranges from neutral to moderately alkaline. This horizon is noncalcareous and is 10 to 20 inches thick.

The B horizon is yellowish brown, light yellowish brown, brownish yellow, brown, grayish brown, light brownish gray, pale brown, and very pale brown. Texture is loam, sandy clay loam, or clay loam.

In the B horizon, clay content exclusive of carbonate clays ranges from 18 to 30 percent. Reaction ranges from neutral in the upper part to moderately alkaline in the lower part. This horizon is calcareous in the lower part. Secondary concretions and soft masses of calcium carbonate are within a depth of 36 inches. Calcium carbonate equivalent in the Bca horizon is 15 to 50 percent, with less than 40 percent in the 10- to 40-inch control section.

The C horizon, if present, is stratified loam, sandy clay loam, or clay loam.

Wichita series

The Wichita series consists of deep, well drained soils on ancient stream terraces on uplands. These soils formed in clayey and loamy deposits. Slopes range from 1 to 3 percent.

Typical pedon of Wichita clay loam, 1 to 3 percent slopes; from the junction of Farm Road 207 and Texas Highway 16 in the town of Strawn, 1.5 miles north on Texas Highway 16, and 60 feet east of right-of-way:

A1—0 to 8 inches; reddish brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; weak fine subangular blocky structure; hard, friable; common fine roots and pores; neutral; clear smooth boundary.
B21t—8 to 25 inches; red (2.5YR 5/6) clay, red (2.5YR 4/6) moist; moderate medium subangular blocky structure; very hard, very firm; common fine roots and pores; many thin clay films on faces of peds; neutral; gradual smooth boundary.
B22t—25 to 35 inches; yellowish red (5YR 5/6) clay loam, yellowish red (5YR 4/6) moist; weak coarse blocky structure; very hard, very firm; few fine roots and pores; few fine concretions and common soft masses of calcium carbonate; few thin clay films on faces of peds; calcareous; moderately alkaline; gradual smooth boundary.
B3ca—35 to 60 inches; brownish yellow (10YR 6/6) clay loam, yellowish brown (10YR 5/6) moist; weak coarse blocky structure; hard, firm; few fine roots; few fine pores; few concretions and many soft masses of calcium carbonate; calcareous; moderately alkaline.

The A horizon is light reddish brown, light brown, reddish brown, or brown. It is loam, clay loam, or silty clay loam.

The B21t horizon is red, reddish brown, or brown. Texture is clay loam, clay, or silty clay. Reaction ranges from neutral to moderately alkaline.

The B22t and B3Ca horizons are reddish brown, red, yellowish red, strong brown, or brownish yellow. The structure is fine and medium subangular blocky in the upper part, grading to medium and coarse blocky structure in the lower part. The structure becomes weaker as depth increases.

These Wichita soils are considered to be taxadjuncts to the Wichita series because hue in the B3 horizon is yellower than 7.5YR. This difference, however, does not affect use, behavior, or management.

Windthorst series

The Windthorst series consists of deep, moderately well drained soils that formed in clayey and loamy materials on uplands. Slopes range from 1 to 3 percent.

Typical pedon of Windthorst fine sandy loam, 1 to 3 percent slopes; from the junction of U.S. Highway 281 and U.S. Highway 180 in the town of Mineral Wells, 12.3 miles north on U.S. Highway 281, and 50 feet east of right-of-way:

A1—0 to 4 inches; brown (7.5YR 5/2) fine sandy loam, dark brown (7.5YR 4/2) moist; weak fine subangular blocky structure; hard, very friable; common fine roots; slightly acid; clear smooth boundary.

A2—4 to 10 inches; light brown (7.5YR 6/4) fine sandy loam, brown (7.5YR 5/4) moist; weak fine subangular blocky structure; hard, very friable; common fine roots; slightly acid; abrupt smooth boundary.

B21t—10 to 25 inches; red (2.5YR 5/6) clay, red (2.5YR 4/6) moist; moderate medium subangular blocky structure; extremely hard, very firm; few fine roots; few fine pores; nearly continuous clay films on faces of peds; medium acid; gradual wavy boundary.

B22t—25 to 45 inches; red (2.5YR 5/6) clay, red (2.5YR 4/6) moist; common medium distinct reddish yellow (7.5YR 6/6) mottles; moderate medium subangular blocky structure; extremely hard, very firm; few fine roots; few fine pores; common discontinuous clay films on faces of peds; medium acid; gradual wavy boundary.

B3—45 to 55 inches; yellowish red (5YR 5/6) clay, yellowish red (5YR 4/6) moist; common medium distinct reddish yellow (5YR 6/6) mottles; moderate medium subangular blocky structure; extremely hard, very firm; few patchy clay films; medium acid; gradual wavy boundary.

C—55 to 60 inches; yellowish red (5YR 5/6) clay, yellowish red (5YR 4.6) moist, stratified with light brown (7.5YR 6/4) fine sandy loam; medium acid.

Solum thickness ranges from 35 to 60 inches. The A1 horizon is brown, pale brown, light brownish gray, grayish brown, yellowish brown, reddish yellow, dark grayish brown, or light yellowish brown. The A2 horizon is lighter in color than the A1 horizon. Reaction is medium acid to neutral.

The B21t horizon is red, reddish brown, or yellowish red. Texture is clay or sandy clay. Reaction is medium acid or slightly acid.

The B22t horizon is red, or yellowish red and commonly has mottles in shades of red, yellow, and brown. Texture is clay, sandy clay, or clay loam. Reaction ranges from medium acid to neutral.

The B3 horizon is red or yellowish red with mottles in shades of red, yellow, and brown. Texture is clay, sandy clay, or clay loam. Lenses or pockets of sandy clay loam, fine sandy loam, or weakly cemented fine sandy loam are common. Reaction ranges from medium acid to mildly alkaline.

Texture of the C horizon is massive clay, clayey shale, sandy clay loam, clay loam, or fine sandy loam and grades to weakly cemented sandstone. Reaction ranges from medium acid to moderately alkaline.

Yahola series

The Yahola series consists of deep, well drained soils that formed in slightly altered, loamy calcareous alluvium on bottom lands. Slopes range from 0 to 5 percent.

Typical pedon of Yahola very fine sandy loam, in an area of Yahola and Gaddy soils, occasionally flooded; from the junction of U.S. Highways 281 and 180, 4.1 miles south and east on county road, and 1.5 miles south and east along pasture road to riverbank:

A1—0 to 8 inches; light reddish brown (5YR 6/4) very fine sandy loam, reddish brown (5YR 5/4) moist; weak fine subangular blocky structure; slightly hard, very friable; common fine roots; moderately alkaline; calcareous; abrupt smooth boundary.

A12—8 to 22 inches; reddish yellow (5YR 6/6) very fine sandy loam, yellowish red (5YR 5/6) moist; weak fine subangular blocky structure; slightly hard, very friable; common fine roots; moderately alkaline; calcareous; abrupt smooth boundary.

C1—22 to 45 inches; reddish brown (5YR 5/4) very fine sandy loam, light reddish brown (5YR 6/4) moist; massive; slightly hard, very friable; few fine roots; common bedding planes; moderately alkaline; calcareous; abrupt smooth boundary.

C2—45 to 52 inches; reddish yellow (5YR 6/6) silt loam, yellowish red (5YR 5/6) moist; massive; slightly hard, very friable; few fine roots; common bedding planes; moderately alkaline; calcareous; abrupt smooth boundary.

C3—52 to 62 inches; pink (5YR 7/4) loamy fine sand, light reddish brown (5YR 6/4) moist; massive; loose, dry and moist; few fine roots; moderately alkaline; calcareous.

The A horizon is brown, pinkish gray, light brown, pink, strong brown, reddish yellow, reddish brown, light reddish brown, or yellowish red. Texture is fine sandy loam, loam, or very fine sandy loam. Thickness ranges from 8 to 25 inches.

The C horizon is brown, light brown, strong brown, reddish yellow, reddish brown, light reddish brown, pink, or red. Texture is stratified loam, fine sandy loam, or very fine sandy loam. Thin strata of clay, clay loam, silty loam, loamy sand, or loamy fine sand are common below a depth of 40 inches.

formation of the soils

In this section, the processes of soil formation are discussed and related to the soils in the survey area.

factors of soil formation

Soil is formed by the action of soil-forming processes on materials deposited or accumulated by geologic forces. The characteristics of the soil at any given point are determined by climate; plant and animal life in and on the soil; the physical and mineralogical composition of the parent material; the relief, or lay of the land; and the length of time that the forces of soil formation have acted on the parent material.

The interrelationship among these five factors of soil formation is complex, and the effect of any one factor cannot be isolated. Each factor is discussed separately in the following paragraphs, but it is the interaction of all these factors that determines the nature of the soil.

climate

Palo Pinto County has a warm-temperate, subhumid climate with hot summers. This climate contributes to the formation of soils in several ways. Expansion of the soil at high temperatures and contraction at low temperatures fracture parent rock and soil material and hasten weathering. Patterns of rainfall distribution cause the soils to be alternately wet and dry. When a clay soil, such as Leeray clay, dries, it becomes severely cracked. The cracks fill with water during rainfall. After the clay soil becomes wet, it swells enough to close the cracks. This alternate shrinking and swelling causes the soil to churn and offsets the downward movement of clay into the subsoil. Other soils, such as Truce and Demona soils, have clayey lower layers.

Water moving through the soil carries clay particles downward from the surface layer and deposits them as the movement of water slows. As clay accumulates, the water moves even slower, and deposition of clay accelerates. Thus, the process tends to speed up, and the lower layers eventually become clayey.

Wind also affects the formation of soils in the county. The Patilo, Decordova, and Eufaula soils have been reworked by wind.

plant and animal life

Plants and animal life are important in the formation of soils. Gains in organic matter, gains or losses in plant nutrients, and changes in structure and porosity are among the changes caused by living organisms.

Tall grass prairie influenced the development of the Set, Velow, Palopinto, and Blanket soils. These plants provided litter that protected the surface and added organic matter to the dark soils. The roots reached deep into the soil and fed on minerals at lower depths. Lime, minerals, and organic matter were distributed throughout the soil profile as these plants died and decomposed. The decomposed plant roots left channels that increased the intake of water and the aeration of the soil. Earthworms and other organisms fed on the decomposed roots. The borings of earthworms also helped channel water and air through the soil.

Oak-savannah vegetation has affected the formation of the Chaney, Demona, Truce, and Bonti soils. These soils have less organic matter than soils that formed under tall grass prairie.

Man has also influenced soil formation. He permitted cattle to graze the vegetation on the land. He plowed the land and planted crops. These activities generally caused the surface layer to become thinner and more clayey.

parent material

Parent material is the unconsolidated mass from which a soil forms. It determines the limits of the chemical and mineral composition of the soil. In Palo Pinto County, the soils developed from material of three geologic systems. They are the Pennsylvanian, Cretaceous, and Quaternary Systems (*5*).

Most of the soils of this county formed in bedrock of the Pennsylvanian System. The oldest stratigraphic unit, the Lazy Bend Formation, is exposed in the southeastern corner of the county. Materials of younger Pennsylvanian formations are exposed in sequence toward the north and west.

Soils in the southern and eastern parts of the county mainly formed in residuum from sandstone and shale of the Grindstone Creek and Brazos River Formations. These soils mainly are Bonti and Exray soils which are underlain by sandstone. Truce and Owens soils are underlain by shale.

Most of the soils in the western and northern parts of the county formed in residuum from limestone and shale. These soils mainly are Hensley, Lindy, and Palopinto soils which are underlain by the Palo Pinto-Mineral Wells (undivided), Winchell, and Ranger Limestone Formations.

Set and Leeray soils are underlain by the Wolf Mountain Shale Formation.

The Cretaceous System is mainly of the Twin Mountains Formation located in the southeast and northeast corners of the county. Soils that have a sandy or loamy surface layer, such as Chaney and Demona soils, formed in this system.

A sequence of geologic stream terraces of the Quaternary System are in the Brazos River Valley. These terraces are mainly on the inside of the bends of the river and are narrower along less meandering areas. The terrace system includes a terrace about 30 feet above the flood plain, a second terrace about 45 to 60 feet above the flood plain, and a third terrace more than 90 to 120 feet above the flood plain (*3*). The soils mainly are Apalo soils on the first terrace, Bastrop soils on the second terrace, and Minwells soils on the third terrace (*4*).

The valley entrenchment and flood plain abandonment within the Brazos River basin was apparently caused by changes in the river regime because of climatic and base level changes during the Quaternary Period. For each major glacial advance, the river adjusted to increased bankfull discharge and decreased sediment load. Stream adjustment under these conditions involved downcutting below the adjacent flood plain.

The interglacial stages in the past 10 to 12 thousand years were characterized by decreased rainfall and runoff and increased temperature and sediment yield. During the interglacial stages, the Brazos River became underfit to the valley cut by the prior stream but became comparatively more stable. This period of dynamic equilibrium was conducive to the formation of thick valley fill and a broad flood plain. At that time, the flood plain was dissected by the river when it adjusted to conditions produced by the next glacial advance.

The parent material of the soils on flood plains is recent deposits of alluvium. These deposits are from the Quaternary System. Many of these deposits on lower lying flood plains have been reworked from time to time, and new deposits have been made. Gaddy, Yahola, and Santo soils formed in recent deposits. Frio and Bosque soils formed in older alluvial deposits.

relief

Relief affects soil formation through its influence on drainage, erosion, plant cover, and soil temperature.

The relief in Palo Pinto County ranges from nearly level in streams and valleys and on broad uplands to steep on escarpments. Leeray soils have "hog wallow" type gilgai on the more level slopes and "wagon wheel" type gilgai on the more sloping areas. Owens soils formed mainly on south-facing slopes, and Truce soils formed mainly on north-facing slopes in similar material. The soil temperature is higher, plant cover is thinner, and erosion is greater on south-facing slopes. Truce soils are deep and have well defined horizons; Owens soils are shallow and have less distinct horizons than Truce soils.

time

Time, usually a long time, is required for the formation of soils that have distinct horizons. The difference in the length of time that parent materials have been in place, therefore, is commonly reflected in the degree of development of the soil.

Santo and Gaddy soils are examples of young soils with little horizon development. The horizons of these soils show the evidence of stratification, and very little change has occurred from the original, stream-deposited alluvium. Apalo soils are also young soils but are older than the stratified soils.

Demona and Windthorst are examples of older soils that have well developed horizons. The parent material of these soils has been in place for a long time. Clay particles have moved downward from the surface layer and accumulated in the lower layers.

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glossary

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	More than 12

Base saturation. The degree to which material having cation exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation exchange capacity.

Bedding planes. Fine stratifications, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediments.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Caliche. A more or less cemented deposit of calcium carbonate in soils of warm-temperate, subhumid to arid areas. Caliche occurs as soft, thin layers in the soil or as hard, thick beds just beneath the solum, or it is exposed at the surface by erosion.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15.2 to 38.1 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Compressible (in tables). Excessive decrease in volume of soft soil under load.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—
Loose.—Noncoherent when dry or moist; does not hold together in a mass.
Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.
Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.
Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.
Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.
Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.
Soft.—When dry, breaks into powder or individual grains under very slight pressure.
Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. Postponing grazing or arresting grazing for a prescribed period.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:
Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.
Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.
Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.
Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.
Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.
Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.
Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy

material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.
Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.
Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fine textured soil. Sandy clay, silty clay, and clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Gilgai. Commonly a succession of microbasins and microknolls in nearly level areas or of microvalleys and microridges parallel with the slope. Typically, the microrelief of Vertisols—clayey soils having a high coefficient of expansion and contraction with changes in moisture content.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual*. The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.
A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.
B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.
C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Roman numeral II precedes the letter C.
R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants follow disturbance of the surface.

Large stones (in tables). Rock fragments 3 inches (7.5 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Low strength. The soil is not strong enough to support loads.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.20 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor, on the basis of how much the present plant community has departed from the potential.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction

because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Rippable. Bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200-300 draw bar horsepower rating.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and runoff water.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slow intake (in tables). The slow movement of water into the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.5 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 mm in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates

longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Unstable fill (in tables). Risk of caving or sloughing on banks of fill material.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Recorded in the period 1955-76 at Mineral Wells, Texas]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days[1]	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January	55.8	32.3	44.1	83	7	56	1.70	.20	2.80	3	1.3
February	60.7	36.0	48.3	87	16	84	1.71	.55	2.63	4	1.1
March	68.2	43.1	55.6	93	20	252	1.81	.51	2.85	4	.6
April	77.5	54.1	65.8	95	31	474	3.62	1.78	5.12	6	.0
May	84.6	61.5	73.1	99	45	716	4.14	1.71	6.10	6	.0
June	91.8	68.7	80.2	103	56	906	3.11	.88	4.90	4	.0
July	96.4	72.4	84.4	106	63	1,066	2.45	.38	4.01	3	.0
August	96.1	71.4	83.8	107	61	1,048	2.21	.56	3.51	4	.0
September	88.4	65.5	77.0	102	48	810	3.63	1.38	5.43	5	.0
October	78.6	54.2	66.4	96	35	508	2.91	.62	4.68	4	.0
November	66.5	42.5	54.5	87	22	190	1.75	.49	2.76	3	.1
December	59.0	35.0	47.0	83	14	63	1.47	.29	2.37	3	.4
Yearly:											
Average	77.0	53.1	65.0	---	---	---	---	---	---	---	---
Extreme	---	---	---	107	7	---	---	---	---	---	---
Total	---	---	---	---	---	6,173	30.51	23.00	37.65	49	3.5

[1]A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50° F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Recorded in the period 1955-76 at Mineral Wells, Texas]

Probability	Temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	March 14	March 27	April 7
2 years in 10 later than--	March 6	March 20	April 1
5 years in 10 later than--	February 18	March 6	March 20
First freezing temperature in fall:			
1 year in 10 earlier than--	November 15	November 5	October 27
2 years in 10 earlier than--	November 24	November 12	November 2
5 years in 10 earlier than--	December 10	November 26	November 13

TABLE 3.--GROWING SEASON

[Recorded in the period 1955-76 at Mineral Wells, Texas]

Probability	Daily minimum temperature during growing season		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	268	233	213
8 years in 10	277	244	222
5 years in 10	294	264	238
2 years in 10	311	285	254
1 year in 10	320	296	262

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
1	Apalo very fine sandy loam, 1 to 3 percent slopes	3,050	0.5
2	Apalo very fine sandy loam, 3 to 5 percent slopes	1,390	0.2
3	Apalo very fine sandy loam, 5 to 8 percent slopes	2,910	0.5
4	Bastrop loamy fine sand, 1 to 5 percent slopes	1,440	0.2
5	Bastrop fine sandy loam, 1 to 3 percent slopes	4,250	0.7
6	Bastrop fine sandy loam, 3 to 5 percent slopes	3,430	0.5
7	Bastrop fine sandy loam, 1 to 5 percent slopes, eroded	2,240	0.4
8	Blanket clay loam, 0 to 1 percent slopes	3,060	0.5
9	Bonti fine sandy loam, 1 to 3 percent slopes	22,480	3.6
10	Bonti fine sandy loam, 3 to 5 percent slopes	1,780	0.3
11	Bonti-Exray complex, very stony, 1 to 8 percent slopes	41,690	6.6
12	Bosque clay loam, occasionally flooded	17,440	2.8
13	Chaney loamy fine sand, 1 to 5 percent slopes	5,500	0.9
14	Decordova loamy fine sand, 0 to 5 percent slopes	4,590	0.7
15	Demona loamy sand, 0 to 5 percent slopes	1,610	0.3
16	Eufaula loamy fine sand, 5 to 8 percent slopes	260	*
17	Frio clay loam, occasionally flooded	4,280	0.7
18	Frio clay loam, frequently flooded	1,470	0.2
19	Hassee loam, 0 to 1 percent slopes	7,430	1.2
20	Hensley very stony clay loam, 0 to 5 percent slopes	54,910	8.7
21	Leeray clay, 0 to 1 percent slopes	2,770	0.4
22	Leeray clay, 1 to 3 percent slopes	36,650	5.8
23	Leeray clay, 3 to 5 percent slopes	1,810	0.3
24	Lindy clay loam, 1 to 3 percent slopes	17,190	2.7
25	May very fine sandy loam, 0 to 1 percent slopes	1,720	0.3
26	Dumps, mine	100	*
27	Minwells fine sandy loam, 1 to 3 percent slopes	15,140	2.4
28	Minwells fine sandy loam, 3 to 5 percent slopes	1,440	0.2
29	Minwells fine sandy loam, 1 to 5 percent slopes, eroded	3,170	0.5
30	Owens clay, 1 to 5 percent slopes	1,250	0.2
31	Owens very stony clay, 1 to 8 percent slopes	1,920	0.3
32	Owens very stony clay, 8 to 40 percent slopes	12,950	2.1
33	Palopinto extremely stony clay loam, 1 to 8 percent slopes	47,620	7.6
34	Patilo fine sand, 1 to 3 percent slopes	450	0.1
35	Santo fine sandy loam, frequently flooded	17,600	2.8
36	Set clay, 1 to 3 percent slopes	1,710	0.3
37	Set clay, 3 to 5 percent slopes	20,270	3.2
38	Set-Palopinto complex, extremely stony, 8 to 40 percent slopes	74,620	11.9
39	Shatruce very bouldery sandy loam, 8 to 40 percent slopes	21,660	3.4
40	Shavash stony loamy fine sand, 1 to 3 percent slopes	9,730	1.5
41	Thurber clay loam, 0 to 1 percent slopes	3,850	0.6
42	Thurber clay loam, 1 to 3 percent slopes	17,000	2.7
43	Truce fine sandy loam, 1 to 3 percent slopes	8,480	1.3
44	Truce fine sandy loam, 3 to 5 percent slopes	1,850	0.3
45	Truce fine sandy loam, 1 to 5 percent slopes, eroded	19,200	3.0
46	Truce-Bonti complex, extremely stony, 8 to 40 percent slopes	41,220	6.5
47	Vashti loamy fine sand, 1 to 5 percent slopes	18,620	3.0
48	Velow clay loam, 1 to 3 percent slopes	3,380	0.5
49	Velow clay loam, 3 to 5 percent slopes	4,140	0.7
50	Wichita clay loam, 1 to 3 percent slopes	4,680	0.7
51	Windthorst fine sandy loam, 1 to 3 percent slopes	4,020	0.6
52	Yahola and Gaddy soils, occasionally flooded	5,300	0.8
	Water	23,680	3.8
	Total	630,400	100.0

* Less than 0.1 percent.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE

[Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Map symbol and soil name	Grain sorghum	Peanuts	Oats	Wheat	Cotton lint	Improved bermudagrass
	Bu	Lb	Bu	Bu	Lb	AUM*
1---------- Apalo	50	1,100	---	---	---	6.5
2---------- Apalo	30	800	---	---	---	6.0
3---------- Apalo	20	---	---	---	---	5.0
4---------- Bastrop	55	1,400	---	---	350	6.0
5---------- Bastrop	55	1,200	---	---	350	7.0
6---------- Bastrop	45	800	---	---	300	5.5
7---------- Bastrop	40	800	---	---	250	5.0
8---------- Blanket	65	---	65	35	---	6.5
9---------- Bonti	40	---	35	---	---	4.0
10---------- Bonti	35	---	30	---	---	3.5
11---------- Bonti-Exray	---	---	---	---	---	---
2---------- Bosque	65	---	60	---	450	6.5
13---------- Chaney	35	1,200	---	---	---	6.0
14---------- Decordova	40	1,000	---	---	---	5.5
15---------- Demona	40	1,200	---	---	---	6.0
16---------- Eufaula	---	---	---	---	---	3.5
17---------- Frio	75	---	60	---	450	7.0
18---------- Frio	---	---	---	---	---	7.0
19---------- Hassee	45	---	30	---	---	5.0
20---------- Hensley	---	---	---	---	---	---
21---------- Leeray	55	---	40	25	300	4.0

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Map symbol and soil name	Grain sorghum	Peanuts	Oats	Wheat	Cotton lint	Improved bermudagrass
	Bu	Lb	Bu	Bu	Lb	AUM*
22---------- Leeray	45	---	40	25	250	4.0
23---------- Leeray	35	---	30	20	200	3.5
24---------- Lindy	55	---	45	25	250	5
25---------- May	55	1,400	50	---	---	6.5
26.** Dumps, mine						
27---------- Minwells	45	1,100	40	---	---	5.5
28---------- Minwells	35	1,000	35	---	---	4.5
29---------- Minwells	30	800	30	---	---	4.0
30---------- Owens	---	---	15	10	---	1.5
31---------- Owens	---	---	---	---	---	---
32---------- Owens	---	---	---	---	---	---
33---------- Palopinto	---	---	---	---	---	---
34---------- Patilo	---	1,000	---	---	---	4.5
35. Santo						
36---------- Set	---	---	50	---	---	4.0
37---------- Set	---	---	45	---	---	3.5
38---------- Set-Palopinto	---	---	---	---	---	---
39---------- Shatruce	---	---	---	---	---	---
40---------- Shavash	---	---	---	---	---	3.5
41---------- Thurber	30	---	35	25	---	3.5
42---------- Thurber	30	---	35	20	---	3.5
43---------- Truce	35	---	30	---	---	4.0
44---------- Truce	30	---	20	---	---	4.0

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Map symbol and soil name	Grain sorghum	Peanuts	Oats	Wheat	Cotton lint	Improved bermudagrass
	Bu	Lb	Bu	Bu	Lb	AUM*
45---------- Truce	25	---	15	---	---	3.0
46---------- Truce-Bo..ti	---	---	---	---	---	---
47---------- Vashti	35	1,100	---	---	---	5.0
48---------- Velow	60	---	50	---	---	6.0
49---------- Velow	50	---	40	---	---	5.5
50---------- Wichita	25	---	---	20	225	---
51---------- Windthorst	45	1,100	40	---	---	6.0
52---------- Yahola and Gaddy	---	---	---	20	---	6.0

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 6.--CAPABILITY CLASSES AND SUBCLASSES

[Miscellaneous areas are excluded. Absence of an entry indicates no acreage]

Class	Total acreage	Major management concerns (Subclass)			
		Erosion (e)	Wetness (w)	Soil problem (s)	Climate (c)
		Acres	Acres	Acres	Acres
I	4,780	---	---	---	---
II	92,620	67,190	25,430	---	---
III	177,600	161,960	7,430	8,210	---
IV	5,970	5,970	---	---	---
V	19,070	---	19,070	---	---
VI	156,130	260	---	155,870	---
VII	128,790	---	---	128,790	---
VIII	21,660	---	---	21,660	---

TABLE 7.--RANGELAND PRODUCTIVITY

[Only the soils that support rangeland vegetation suitable for grazing are listed]

Map symbol and soil name	Range site name	Potential annual production for kind of growing season		
		Favorable	Average	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
1, 2, 3--Apalo	Sandy Loam	5,500	4,500	3,000
4--Bastrop	Loamy Sand	5,500	4,200	2,500
5, 6, 7--Bastrop	Sandy Loam	5,500	4,500	3,000
8--Blanket	Clay Loam	6,000	4,500	3,000
9, 10--Bonti	Tight Sandy Loam	4,000	3,500	2,000
11:*				
Bonti	Tight Sandy Loam	4,000	3,500	2,000
Exray	Sandy Loam	5,000	4,000	2,500
12--Bosque	Loamy Bottomland	6,500	5,000	3,500
13--Chaney	Loamy Sand	4,500	4,000	3,000
14--Decordova	Loamy Sand	5,000	4,000	2,000
15--Demona	Sandy	4,500	3,500	2,000
16--Eufaula	Deep Sand	4,000	2,800	2,000
17, 18--Frio	Loamy Bottomland	6,500	5,000	3,000
19--Hassee	Claypan Prairie	4,000	3,000	2,000
20--Hensley	Redland	7,000	4,000	3,000
21, 22, 23--Leeray	Clay Loam	4,500	3,500	2,500
24--Lindy	Deep Redland	6,000	5,000	4,000
25--May	Sandy Loam	6,000	5,000	3,500
27, 28, 29--Minwells	Sandy Loam	5,000	4,000	3,000
30, 31--Owens	Shallow Clay	3,000	2,000	1,500
32--Owens	Rocky Hill	1,700	1,200	900
33--Palopinto	Low Stony Hill	3,500	3,000	1,000

See footnote at end of table.

TABLE 7.--RANGELAND PRODUCTIVITY--Continued

Map symbol and soil name	Range site name	Potential annual production for kind of growing season		
		Favorable	Average	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
34---------- Patilo	Deep Sand----------	3,000	2,000	1,000
35---------- Santo	Loamy Bottomland----------	6,000	4,500	3,000
36, 37---------- Set	Clay Loam----------	4,500	3,500	2,500
38:*				
Set----------	Clay Loam Slope----------	4,000	3,000	2,000
Palopinto----------	Steep Rocky----------	3,000	2,500	1,000
39---------- Shatruce	Bouldery Hills----------	3,000	1,500	700
40---------- Shavash	Loamy Sand----------	4,500	3,500	2,000
41, 42---------- Thurber	Claypan Prairie----------	3,500	3,000	2,000
43, 44, 45---------- Truce	Tight Sandy Loam----------	4,000	3,000	2,000
46:*				
Truce----------	Sandstone Hill----------	4,000	3,000	2,500
Bonti----------	Sandstone Hill----------	6,000	3,000	2,000
47---------- Vashti	Loamy Sand----------	5,000	4,000	2,500
48, 49---------- Velow	Clay Loam----------	6,000	4,500	3,000
50---------- Wichita	Clay Loam----------	4,500	3,500	2,500
51---------- Windthorst	Sandy Loam----------	6,000	4,500	3,000
52:*				
Yahola----------	Loamy Bottomland----------	6,000	4,900	3,500
Gaddy----------	Sandy Bottomland----------	3,800	2,700	2,000

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails
1, 2--Apalo	Slight	Slight	Moderate: slope.	Severe: erodes easily.
3--Apalo	Slight	Slight	Severe: slope.	Severe: erodes easily.
4, 5, 6, 7--Bastrop	Slight	Slight	Moderate: slope.	Severe: erodes easily.
8--Blanket	Slight	Slight	Slight	Slight.
9, 10--Bonti	Slight	Slight	Moderate: slope, depth to rock.	Severe: erodes easily.
11:*				
Bonti	Moderate: large stones.	Moderate: large stones.	Severe: large stones.	Moderate: large stones.
Exray	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, large stones.	Slight.
12--Bosque	Severe: floods.	Slight	Moderate: floods.	Slight.
13--Chaney	Slight	Slight	Moderate: slope.	Slight.
14--Decordova	Slight	Slight	Moderate: slope.	Slight.
15--Demona	Moderate: wetness.	Moderate: wetness.	Moderate: slope.	Moderate: wetness.
16--Eufaula	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
17--Frio	Severe: floods.	Slight	Moderate: floods.	Slight.
18--Frio	Severe: floods.	Moderate: floods.	Severe: floods.	Moderate: floods.
19--Hassee	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: wetness, percs slowly.	Severe: erodes easily.
20--Hensley	Severe: depth to rock.	Severe: depth to rock.	Severe: large stones, depth to rock.	Moderate: large stones.
21--Leeray	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Moderate: too clayey, percs slowly.	Moderate: too clayey.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails
22, 23---------- Leeray	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Moderate: slope, too clayey, percs slowly.	Moderate: too clayey.
24---------- Lindy	Slight----------	Slight----------	Slight----------	Slight.
25---------- May	Slight----------	Slight----------	Slight----------	Severe: erodes easily.
26.* Dumps, mine				
27, 28, 29---------- Minwells	Slight----------	Slight----------	Moderate: slope.	Slight.
30---------- Owens	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Severe: too clayey.	Moderate: too clayey.
31---------- Owens	Moderate: large stones, too clayey.	Moderate: large stones, too clayey.	Severe: large stones, too clayey.	Moderate: large stones, too clayey.
32---------- Owens	Severe: slope.	Severe: slope.	Severe: slope, large stones, too clayey.	Moderate: large stones, too clayey.
33---------- Palopinto	Severe: large stones, depth to rock.	Severe: large stones, depth to rock.	Severe: large stones, depth to rock.	Moderate: large stones.
34---------- Patilo	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
35---------- Santo	Severe: floods.	Moderate: floods.	Severe: floods.	Moderate: floods.
36, 37---------- Set	Moderate: too clayey.	Moderate: too clayey.	Moderate: slope, too clayey.	Moderate: too clayey.
38:* Set----------	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: large stones.
Palopinto----------	Severe: slope, large stones, depth to rock.	Severe: slope, large stones, depth to rock.	Severe: large stones, slope, depth to rock.	Severe: large stones.
39---------- Shatruce	Severe: slope.	Severe: slope.	Severe: large stones, slope, small stones.	Severe: slope.
40---------- Shavash	Severe: depth to rock.	Severe: depth to rock.	Severe: small stones, depth to rock.	Severe: erodes easily.
41---------- Thurber	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: percs slowly.	Severe: erodes easily.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails
42--Thurber	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Severe: erodes easily.
43, 44, 45--Truce	Slight	Slight	Moderate: slope.	Slight.
46:*				
Truce	Severe: slope.	Severe: slope.	Severe: slope, large stones.	Severe: slope.
Bonti	Severe: slope.	Severe: slope.	Severe: slope, large stones.	Severe: slope.
47--Vashti	Slight	Slight	Moderate: slope, depth to rock.	Slight.
48, 49--Velow	Slight	Slight	Moderate: slope.	Slight.
50--Wichita	Slight	Slight	Moderate: slope.	Slight.
51--Windthorst	Slight	Slight	Moderate: slope.	Severe: erodes easily.
52:*				
Yahola	Severe: floods.	Slight	Moderate: floods.	Slight.
Gaddy	Severe: floods.	Slight	Moderate: floods.	Slight.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--WILDLIFE HABITAT POTENTIALS

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Map symbol and soil name	Potential for habitat elements								Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
1---------- Apalo	Good	Good	Good	---	---	Good	Poor	Very poor.	Good	Very poor	Good.
2, 3---------- Apalo	Fair	Fair	Good	---	---	Good	Poor	Very poor.	Fair	Very poor	Good.
4---------- Bastrop	Fair	Good	Good	---	---	Good	Poor	Very poor.	Good	Very poor	Good.
5---------- Bastrop	Good	Good	Good	---	---	Good	Poor	Very poor.	Good	Very poor	Good.
6---------- Bastrop	Fair	Good	Good	---	---	Good	Poor	Very poor.	Good	Very poor	Good.
7---------- Bastrop	Fair	Good	Good	---	---	Good	Poor	Very poor.	Good	Very poor	Good.
8---------- Blanket	Good	Good	Fair	---	Good	Good	Poor	Very poor.	Good	Very poor	Fair.
9---------- Bonti	Good	Good	Good	---	---	Good	Poor	Very poor.	Good	Very poor	Good.
10---------- Bonti	Fair	Good	Good	---	---	Good	Poor	Very poor.	Good	Very poor	Good.
11:* Bonti----------	Poor	Poor	Good	---	---	Good	Poor	Very poor.	Fair	Very poor	Good.
Exray----------	Poor	Poor	Fair	Fair	---	Fair	Very poor.	Very poor.	Poor	Very poor	Fair.
12---------- Bosque	Good	Good	Good	---	---	Good	Poor	Very poor.	Good	Very poor	Good.
13---------- Chaney	Fair	Good	Good	---	---	Good	Poor	Very poor.	Good	Very poor	Good.
14---------- Decordova	Fair	Fair	Good	---	---	Good	Poor	Very poor.	Fair	Very poor	Good.
15---------- Demona	Fair	Good	Good	---	---	Good	Poor	Very poor.	Good	Very poor	Good.
16---------- Eufaula	Poor	Fair	Fair	Fair	Fair	Good	Very poor.	Very poor.	Fair	Very poor	Fair.
17---------- Frio	Good	Good	Fair	---	---	Good	Poor	Very poor.	Good	Very poor	Fair.
18---------- Frio	Very poor.	Poor	Fair	---	---	Good	Poor	Very poor.	Poor	Very poor	Fair.
19---------- Hassee	Fair	Fair	Fair	---	---	Fair	Fair	Fair	Fair	Fair	Fair.
20---------- Hensley	Poor	Poor	Fair	---	Poor	Fair	Very poor.	Very poor.	Poor	Very poor	Fair.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT POTENTIALS--Continued

Map symbol and soil name	Potential for habitat elements								Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
21, 22, 23--------- Leeray	Fair	Fair	Fair	---	---	Fair	Poor	Very poor.	Fair	Very poor	Fair.
24---------- Lindy	Fair	Good	Good	---	Poor	Good	Very poor.	Very poor.	Good	Very poor	Good.
25---------- May	Good	Good	Good	---	---	Good	Poor	Very poor.	Good	Very poor	Good.
26.* Dumps, mine											
27---------- Minwells	Good	Good	Good	---	---	Good	Very poor.	Very poor.	Good	Very poor	Good.
28---------- Minwells	Fair	Good	Good	---	---	Good	Very poor.	Very poor.	Good	Very poor	Good.
29---------- Minwells	Fair	Good	Good	---	---	Good	Very poor.	Very poor.	Good	Very poor	Good.
30---------- Owens	Fair	Fair	Fair	---	---	Poor	Very poor.	Very poor.	Fair	Very poor	Poor.
31---------- Owens	Poor	Poor	Fair	---	---	Fair	Poor	Very poor.	Poor	Very poor	Poor.
32---------- Owens	Very poor.	Very poor.	Fair	---	---	Fair	Very poor.	Very poor.	Very poor	Very poor	Poor.
33---------- Palopinto	Poor	Poor	Fair	---	---	Fair	Poor	Very poor.	Fair	Very poor	Fair.
34---------- Patilo	Fair	Good	Fair	---	---	Fair	Poor	Very poor.	Fair	Very poor	Fair.
35---------- Santo	Very poor.	Poor	Fair	Fair	---	---	Poor	Very poor.	Poor	Fair	Fair.
36---------- Set	Good	Good	Fair	---	---	Fair	Very poor.	Poor	Good	Very poor	Fair.
37---------- Set	Fair	Good	Fair	---	---	Fair	Very poor.	Very poor.	Fair	Very poor	Fair.
38:* Set----------	Very poor.	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	Very poor	Fair.
Palopinto---------	Poor	Poor	Fair	---	---	Fair	Poor	Very poor.	Fair	Very poor.	Fair.
39---------- Shatruce	Very poor.	Very poor.	Good	---	---	Good	Very poor.	Very poor.	Very poor	Very poor	Good.
40---------- Shavash	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	Very poor	Fair.
41, 42---------- Thurber	Fair	Fair	Fair	---	---	Fair	Poor	Poor	Fair	Poor	Fair.
43---------- Truce	Good	Good	Good	---	---	Good	Poor	Very poor.	Good	Very poor	Good.
44---------- Truce	Fair	Good	Good	---	---	Good	Poor	Very poor.	Good	Very poor	Good.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT POTENTIALS--Continued

Map symbol and soil name	Potential for habitat elements								Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
45---------- Truce	Fair	Good	Good	---	---	Good	Poor	Very poor.	Good	Very poor	Good.
46:*											
Truce----------	Very poor.	Very poor.	Good	---	---	Good	Very poor.	Very poor.	Poor	Very poor	Good.
Bonti----------	Very poor.	Very poor.	Good	---	---	Good	Very poor.	Very poor.	Poor	Very poor	Good.
47---------- Vashti	Fair	Good	Good	---	---	Good	Poor	Very poor.	Good	Very poor	Good.
48---------- Velow	Good	Good	Good	---	---	Fair	Poor	Very poor.	Good	Very poor	Fair.
49---------- Velow	Fair	Good	Good	---	---	Fair	Poor	Very poor.	Good	Very poor	Fair.
50---------- Wichita	Good	Good	Fair	---	Very poor.	Fair	Very poor.	Very poor.	Good	Very poor	Fair.
51---------- Windthorst	Good	Good	Good	---	---	Good	Poor	Very poor.	Good	Very poor	Good.
52:*											
Yahola----------	Good	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Very poor	Good.
Gaddy----------	Fair	Fair	Fair	Fair	---	Fair	Very poor.	Very poor.	Fair	Very poor	Fair.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
1---------- Apalo	Slight---------	Slight---------	Slight---------	Slight---------	Slight---------	Slight.
2, 3---------- Apalo	Slight---------	Slight---------	Slight---------	Moderate: slope.	Slight---------	Slight.
4, 5---------- Bastrop	Slight---------	Slight---------	Slight---------	Slight---------	Moderate: low strength.	Slight.
6---------- Bastrop	Slight---------	Slight---------	Slight---------	Moderate: slope.	Moderate: low strength.	Slight.
7---------- Bastrop	Slight---------	Slight---------	Slight---------	Slight---------	Moderate: low strength.	Slight.
8---------- Blanket	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
9---------- Bonti	Moderate: depth to rock, too clayey.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Moderate: thin layer.
10---------- Bonti	Moderate: depth to rock, too clayey.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Moderate: thin layer.
11:*						
Bonti----------	Moderate: depth to rock, too clayey.	Moderate: depth to rock, shrink-swell.	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: low strength.	Severe: large stones, slope.
Exray----------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, low strength.	Severe: thin layer, slope.
12---------- Bosque	Moderate: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: low strength, floods.	Moderate: floods.
13---------- Chaney	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
14---------- Decordova	Slight---------	Slight---------	Slight---------	Slight---------	Slight---------	Slight.
15---------- Demona	Severe: cutbanks cave, wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength.	Moderate: wetness, droughty.
16---------- Eufaula	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Slight---------	Moderate: droughty.
17---------- Frio	Moderate: too clayey, floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: low strength, floods.	Moderate: floods.
18---------- Frio	Moderate: too clayey, floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: low strength, floods.	Severe: floods.
19---------- Hassee	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, shrink-swell.	Moderate: wetness.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
20---------- Hensley	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, low strength.	Severe: thin layer, large stones.
21, 22, 23-------- Leeray	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Severe: too clayey.
24---------- Lindy	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Severe: low strength.	Moderate: small stones, large stones, thin layer.
25---------- May	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: low strength, shrink-swell.	Slight.
26.* Dumps, mine						
27---------- Minwells	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
28---------- Minwells	Moderate: too clayey	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
29---------- Minwells	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
30---------- Owens	Severe: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Severe: too clayey.
31---------- Owens	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Severe: too clayey, large stones.
32---------- Owens	Severe: slope.	Severe: shrink-swell, slope.	Severe: shrink-swell, slope.	Severe: shrink-swell, slope.	Severe: shrink-swell, slope, low strength.	Severe: slope, large stones, too clayey.
33---------- Palopinto	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, low strength.	Severe: large stones, thin layer.
34---------- Patilo	Severe: cutbanks cave.	Slight---------	Moderate: wetness.	Slight---------	Slight---------	Moderate: droughty.
35---------- Santo	Severe: cutbanks cave.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.
36---------- Set	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Severe: too clayey.
37---------- Set	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Severe: too clayey.
38:* Set----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: too clayey, slope.
Palopinto--------	Severe: depth to rock, large stones, slope.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, slope, large stones.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, low strength, slope.	Severe: large stones, slope, thin layer.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
39---------- Shatruce	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: large stones, slope.
40---------- Shavash	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: thin layer.
41, 42---------- Thurber	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Slight.
43---------- Truce	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Moderate: droughty.
44---------- Truce	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Moderate: droughty.
45---------- Truce	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Moderate: droughty.
46:* Truce----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope, large stones.
Bonti----------	Severe: slope, depth to rock.	Severe: slope.	Severe: slope, depth to rock.	Severe: slope.	Severe: slope, low strength.	Severe: large stones, slope.
47---------- Vashti	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: thin layer.
48---------- Velow	Slight---------	Slight---------	Slight---------	Slight---------	Moderate: low strength.	Slight.
49---------- Velow	Slight---------	Slight---------	Slight---------	Moderate: slope.	Moderate: low strength.	Slight.
50---------- Wichita	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
51---------- Windthorst	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
52:* Yahola----------	Moderate: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: floods.
Gaddy----------	Severe: cutbanks cave.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: droughty, floods.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated]

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1, 2, 3--- Apalo	Slight---	Moderate: seepage, slope.	Slight---	Slight---	Good.
4, 5, 6, 7--- Bastrop	Moderate: percs slowly.	Moderate: seepage, slope.	Slight---	Slight---	Good.
8--- Blanket	Severe: percs slowly.	Moderate: seepage.	Severe: too clayey.	Slight---	Poor: too clayey, hard to pack.
9, 10--- Bonti	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey.
11:* Bonti---	Severe: percs slowly, depth to rock.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, thin layer.
Exray---	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, thin layer, large stones.
12--- Bosque	Severe: floods.	Moderate: seepage.	Severe: floods.	Severe: floods.	Fair: too clayey.
13--- Chaney	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Severe: seepage.	Poor: too clayey, hard to pack.
14--- Decordova	Slight---	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
15--- Demona	Severe: wetness, percs slowly.	Severe: seepage, wetness.	Severe: wetness, too clayey.	Severe: seepage.	Poor: too clayey, hard to pack.
16--- Eufaula	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
17, 18--- Frio	Severe: floods, percs slowly.	Severe: floods.	Severe: floods, too clayey.	Severe: floods.	Poor: hard to pack, too clayey.
19--- Hassee	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
20--- Hensley	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, thin layer.
21--- Leeray	Severe: percs slowly.	Slight---	Severe: too clayey.	Slight---	Poor: too clayey, hard to pack.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
22, 23---------- Leeray	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight----------	Poor: too clayey, hard to pack.
24---------- Lindy	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
25---------- May	Slight----------	Moderate: seepage.	Slight----------	Slight----------	Good.
26.* Dumps, mine					
27, 28, 29---------- Minwells	Severe: percs slowly.	Severe: seepage.	Severe: seepage.	Slight----------	Fair: too clayey.
30, 31---------- Owens	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight----------	Poor: too clayey, hard to pack.
32---------- Owens	Severe: percs slowly, slope.	Severe: slope.	Severe: slope, too clayey.	Severe: slope.	Poor: slope, too clayey, hard to pack.
33---------- Palopinto	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock.	Poor: area reclaim, hard to pack, large stones.
34---------- Patilo	Severe: percs slowly, poor filter.	Severe: seepage, wetness.	Severe: too sandy.	Severe: seepage.	Poor: seepage, too sandy.
35---------- Santo	Severe: floods.	Severe: seepage, floods.	Severe: floods, seepage.	Severe: floods, seepage.	Fair: too sandy.
36, 37---------- Set	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight----------	Poor: too clayey, hard to pack.
38:*					
Set----------	Severe: percs slowly, slope.	Severe: slope.	Severe: slope, too clayey.	Severe: slope.	Poor: too clayey, hard to pack, slope.
Palopinto----------	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope.	Poor: area reclaim, hard to pack, large stones.
39---------- Shatruce	Severe: percs slowly, slope.	Severe: slope, large stones.	Severe: slope, too clayey.	Severe: slope.	Poor: too clayey, slope.
40---------- Shavash	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, thin layer.
41---------- Thurber	Severe: percs slowly.	Slight----------	Severe: too clayey.	Slight----------	Poor: too clayey, hard to pack.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
42---------- Thurber	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight----------	Poor: too clayey, hard to pack.
43, 44, 45---------- Truce	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight----------	Poor: too clayey, hard to pack.
46:* Truce----------	Severe: percs slowly, slope.	Severe----------	Severe: slope, too clayey.	Severe: slope.	Poor: slope, too clayey, hard to pack.
Bonti----------	Severe: depth to rock, percs slowly, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope, too clayey.	Severe: depth to rock, slope.	Poor: area reclaim, too clayey, slope.
47---------- Vashti	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: thin layer, area reclaim.
48, 49---------- Velow	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight----------	Fair: too clayey.
50---------- Wichita	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight----------	Poor: too clayey.
51---------- Windthorst	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight----------	Poor: too clayey, hard to pack.
52:* Yahola----------	Severe: floods.	Severe: seepage, floods.	Severe: floods, seepage.	Severe: floods, seepage.	Good.
Gaddy----------	Severe: floods, poor filter.	Severe: seepage, floods.	Severe: floods, seepage, too sandy.	Severe: floods, seepage.	Poor: too sandy.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," "probable," and "improbable." Absence of an entry indicates that the soil was not rated]

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
1, 2, 3---- Apalo	Good----	Improbable: excess fines.	Improbable: excess fines.	Good.
4---- Bastrop	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy.
5, 6, 7---- Bastrop	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
8---- Blanket	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
9, 10---- Bonti	Poor: low strength, area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
11:*				
Bonti----	Poor: low strength, area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, large stones.
Exray----	Poor: thin layer, low strength, area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, large stones.
12---- Bosque	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
13---- Chaney	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy, thin layer.
14---- Decordova	Good----	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy,
15---- Demona	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy.
16---- Eufaula	Slight----	Probable----	Improbable: too sandy.	Poor: too sandy.
17, 18---- Frio	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
19---- Hassee	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
20---- Hensley	Poor: thin layer, low strength, area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, thin layer, large stones.
21, 22, 23---- Leeray	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
24---------- Lindy	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
25---------- May	Fair: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Good.
26.* Dumps, mine				
27, 28, 29---------- Minwells	Good----------	Probable----------	Probable----------	Poor: too clayey.
30---------- Owens	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, too clayey.
31---------- Owens	Poor: low strength, slope, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, area reclaim.
32---------- Owens	Poor: low strength, slope, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope, area reclaim, too clayey.
33---------- Palopinto	Poor: area reclaim, low strength, large stones.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: area reclaim, large stones.
34---------- Patilo	Good----------	Probable----------	Improbable: too sandy.	Poor: too sandy.
35---------- Santo	Good----------	Improbable: excess fines.	Improbable: excess fines.	Good.
36, 37---------- Set	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
38:* Set----------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, slope.
Palopinto----------	Poor: area reclaim, low strength, large stones.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: area reclaim, large stones, slope.
39---------- Shatruce	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
40---------- Shavash	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, thin layer.
41, 42---------- Thurber	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
43, 44, 45---------- Truce	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
46:*				
Truce	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope, too clayey.
Bonti	Poor: low strength, area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, slope.
47--- Vashti	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, thin layer.
48, 49--- Velow	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
50--- Wichita	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
51--- Windthorst	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
52:*				
Yahola	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Gaddy	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated]

Map symbol and soil name	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
1---------- Apalo	Moderate: seepage.	Severe: piping.	Deep to water	Erodes easily	Erodes easily	Erodes easily.
2, 3---------- Apalo	Moderate: seepage.	Severe: piping.	Deep to water	Slope, erodes easily.	Erodes easily	Erodes easily.
4---------- Bastrop	Moderate: seepage.	Moderate: piping.	Deep to water	Fast intake, soil blowing, slope.	Erodes easily, soil blowing.	Erodes easily.
5---------- Bastrop	Moderate: seepage.	Moderate: piping.	Deep to water	Soil blowing---	Erodes easily, soil blowing.	Erodes easily.
6, 7---------- Bastrop	Moderate: seepage.	Moderate: piping.	Deep to water	Soil blowing, slope.	Erodes easily, soil blowing.	Erodes easily.
8---------- Blanket	Moderate: seepage.	Moderate: hard to pack.	Deep to water	Favorable------	Erodes easily	Erodes easily.
9---------- Bonti	Moderate: depth to rock.	Severe: thin layer.	Deep to water	Soil blowing, depth to rock.	Depth to rock, erodes easily, soil blowing.	Erodes easily, depth to rock.
10---------- Bonti	Moderate: depth to rock, slope.	Severe: thin layer.	Deep to water	Soil blowing, depth to rock.	Depth to rock, erodes easily, soil blowing.	Erodes easily, depth to rock.
11:* Bonti----------	Moderate: depth to rock, slope.	Moderate: thin layer.	Deep to water	Depth to rock, slope.	Large stones, depth to rock.	Large stones, depth to rock.
Exray----------	Severe: depth to rock.	Severe: thin layer.	Deep to water	Depth to rock, slope.	Depth to rock	Depth to rock.
12---------- Bosque	Moderate: seepage.	Moderate: piping.	Deep to water	Floods---------	Favorable------	Favorable.
13---------- Chaney	Slight--------- slope.	Severe: hard to pack.	Deep to water	Fast intake, soil blowing, percs slowly.	Soil blowing, percs slowly.	Percs slowly.
14---------- Decordova	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake.	Favorable------	Droughty.
15---------- Demona	Severe: seepage.	Moderate: hard to pack, wetness.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, soil blowing.	Droughty.
16---------- Eufaula	Severe: seepage.	Severe: seepage.	Deep to water	Fast intake, droughty, soil blowing.	Too sandy, soil blowing.	Droughty.
17, 18---------- Frio	Slight---------	Moderate: hard to pack.	Deep to water	Floods---------	Favorable------	Favorable.
19---------- Hassee	Slight---------	Moderate: hard to pack, wetness.	Percs slowly---	Wetness, percs slowly, erodes easily.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.
20---------- Hensley	Severe: depth to rock.	Severe: thin layer.	Deep to water	Depth to rock, droughty, percs slowly.	Large stones, depth to rock, erodes easily.	Large stones, erodes easily, droughty.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Map symbol and soil name	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
21, 22---------- Leeray	Slight---------	Severe: hard to pack.	Deep to water	Slow intake, percs slowly.	Percs slowly---	Percs slowly.
23---------- Leeray	Slight---------	Severe: hard to pack.	Deep to water	Slow intake, percs slowly, slope.	Percs slowly---	Percs slowly.
24---------- Lindy	Moderate: depth to rock.	Severe: thin layer.	Deep to water	Percs slowly, depth to rock.	Depth to rock, percs slowly.	Depth to rock, percs slowly.
25---------- May	Moderate: seepage.	Moderate: piping.	Deep to water	Erodes easily	Erodes easily	Erodes easily.
26.* Dumps, mine						
27---------- Minwells	Moderate: seepage.	Moderate: thin layer.	Deep to water	Soil blowing, percs slowly.	Soil blowing, percs slowly.	Percs slowly.
28, 29---------- Minwells	Moderate: seepage.	Moderate: thin layer.	Deep to water	Soil blowing, percs slowly, slope.	Soil blowing, percs slowly.	Percs slowly.
30---------- Owens	Slight---------	Moderate: hard to pack.	Deep to water	Slope, droughty, slow intake.	Erodes easily, percs slowly.	Droughty, erodes easily.
31---------- Owens	Slight---------	Moderate: hard to pack.	Deep to water	Slope, droughty, slow intake.	Large stones, erodes easily.	Large stones, droughty, erodes easily.
32---------- Owens	Severe: slope.	Moderate: hard to pack.	Deep to water	Slope, droughty, slow intake.	Large stones, erodes easily, slope.	Large stones, slope, erodes easily.
33---------- Palopinto	Severe: depth to rock.	Severe: large stones, thin layer.	Deep to water	Large stones, depth to rock, slope.	Large stones, depth to rock.	Large stones, depth to rock.
34---------- Patilo	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
35---------- Santo	Severe: seepage.	Severe: seepage, piping.	Deep to water	Floods---------	Favorable------	Favorable.
36---------- Set	Slight---------	Moderate: hard to pack.	Deep to water	Slow intake, percs slowly.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
37---------- Set	Slight---------	Moderate: hard to pack.	Deep to water	Slow intake, percs slowly, slope.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
38:*						
Set----------	Severe: slope.	Moderate: hard to pack, large stones.	Deep to water	Slow intake, percs slowly, slope.	Slope, erodes easily, percs slowly.	Erodes easily, slope.
Palopinto--------	Severe: depth to rock, slope.	Severe: large stones.	Deep to water	Large stones, depth to rock, slope.	Slope, large stones, depth to rock.	Large stones, slope, depth to rock.
39---------- Shatruce	Severe: slope.	Moderate: large stones.	Deep to water	Percs slowly, slope.	Slope, large stones, percs slowly.	Large stones, slope, percs slowly.
40---------- Shavash	Severe: depth to rock.	Severe: thin layer.	Deep to water	Droughty, fast intake, soil blowing.	Depth to rock, erodes easily, soil blowing.	Erodes easily, droughty, depth to rock.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Map symbol and soil name	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
41, 42---------- Thurber	Slight---------	Severe: hard to pack.	Deep to water	Percs slowly, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
43---------- Truce	Slight---------	Moderate: hard to pack.	Deep to water	Droughty, soil blowing, percs slowly.	Percs slowly, soil blowing.	Percs slowly, droughty.
44, 45---------- Truce	Slight---------	Moderate: hard to pack.	Deep to water	Slope, droughty, soil blowing.	Percs slowly, soil blowing.	Percs slowly, droughty.
46:*						
Truce----------	Severe: slope.	Moderate: hard to pack, large stones.	Deep to water	Slope, droughty, percs slowly.	Slope, large stones, percs slowly.	Large stones, slope, droughty.
Bonti----------	Severe: slope.	Moderate: thin layer.	Deep to water	Large stones, depth to rock, slope.	Large stones, depth to rock, slope.	Large stones, slope, depth to rock.
47---------- Vashti	Moderate: seepage, depth to rock.	Severe: thin layer, seepage, piping.	Deep to water	Fast intake, soil blowing, depth to rock.	Depth to rock, soil blowing.	Depth to rock.
48---------- Velow	Moderate: seepage.	Severe: piping.	Deep to water	Favorable------	Favorable------	Favorable.
49---------- Velow	Moderate: seepage.	Severe: piping.	Deep to water	Slope----------	Favorable------	Favorable.
50---------- Wichita	Slight---------	Slight---------	Deep to water	Favorable------	Favorable------	Favorable.
51---------- Windthorst	Slight---------	Moderate: thin layer, hard to pack.	Deep to water	Soil blowing---	Erodes easily, soil blowing.	Erodes easily.
52:*						
Yahola----------	Severe: seepage.	Severe: piping.	Deep to water	Floods---------	Favorable------	Favorable.
Gaddy----------	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Map symbol and soil name	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
1---------- Apalo	0-28	Very fine sandy loam.	CL, ML, CL-ML	A-4	0	100	100	100	70-90	<30	NP-10
	28-80	Loam, very fine sandy loam.	CL, ML, CL-ML	A-4	0	100	100	100	70-90	<30	NP-10
2, 3---------- Apalo	0-30	Very fine sandy loam.	CL, ML, CL-ML	A-4	0	100	100	100	70-90	<30	NP-10
	30-60	Loam, very fine sandy loam.	CL, ML, CL-ML	A-4	0	100	100	100	70-90	<30	NP-10
4---------- Bastrop	0-15	Loamy fine sand	SM, SM-SC	A-2-4, A-4	0	95-100	80-100	75-96	20-50	<20	NP-4
	15-65	Sandy clay loam, clay loam, loam.	CL, SC	A-6	0	95-100	80-100	80-96	40-70	26-40	11-22
5---------- Bastrop	0-13	Fine sandy loam	ML, SM, CL-ML, SM-SC	A-4	0	95-100	80-100	80-100	36-70	18-25	2-7
	13-80	Sandy clay loam, clay loam, loam.	CL, SC	A-6	0	95-100	80-100	80-100	40-70	26-40	11-22
6---------- Bastrop	0-15	Fine sandy loam	ML, SM, CL-ML, SM-SC	A-4	0	95-100	80-100	80-100	36-70	18-25	2-7
	15-70	Sandy clay loam, clay loam, loam.	CL, SC	A-6	0	95-100	80-100	80-100	40-70	26-40	11-22
7---------- Bastrop	0-4	Fine sandy loam	ML, SM, CL-ML, SM-SC	A-4	0	95-100	80-100	80-100	36-70	18-25	2-7
	4-65	Sandy clay loam, clay loam, loam.	CL, SC	A-6	0	95-100	80-100	80-100	40-70	26-40	11-22
8---------- Blanket	0-18	Clay loam--------	CL	A-6	0	95-100	95-100	90-100	60-80	28-40	12-24
	18-32	Clay loam, clay, silty clay.	CL, CH	A-7	0	95-100	95-100	85-100	70-90	41-55	20-32
	32-60	Clay loam, clay, silty clay loam.	CL	A-6, A-7	0	85-100	80-100	70-90	51-85	30-45	15-30
9---------- Bonti	0-9	Fine sandy loam	SM, SM-SC, ML, CL-ML	A-4, A-2-4	0-2	90-100	90-100	70-100	25-70	18-30	2-7
	9-36	Clay, clay loam, sandy clay.	CL	A-6, A-7	0-4	80-100	80-100	70-100	51-75	30-45	18-25
	36-38	Weathered bedrock	---	---	---	---	---	---	---	---	---
10---------- Bonti	0-11	Fine sandy loam	SM, SM-SC, ML, CL-ML	A-4, A-2-4	0-2	90-100	90-100	70-100	25-70	18-30	2-7
	11-32	Clay, clay loam, sandy clay.	CL	A-6, A-7	0-4	80-100	80-100	70-100	51-75	30-45	18-25
	32-34	Weathered bedrock	---	---	---	---	---	---	---	---	---
11:*											
Bonti----------	0-5	Very stony fine sandy loam.	SM, SM-SC, ML, CL-ML	A-2-4, A-4	15-45	80-100	80-100	70-98	25-70	18-30	2-7
	5-24	Clay, sandy clay, clay loam.	CL	A-6, A-7	0-15	80-100	80-100	75-100	55-75	30-45	18-25
	24-26	Weathered bedrock	---	---	---	---	---	---	---	---	---
Exray----------	0-5	Very stony fine sandy loam.	SM-SC, SC	A-2-4, A-4	5-23	85-100	80-100	55-80	30-50	20-30	5-10
	5-16	Clay, sandy clay, clay loam.	CL, SC	A-6, A-7	0-5	85-100	80-100	80-100	48-80	30-45	15-25
	16-17	Weathered bedrock	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
12---------- Bosque	0-34	Clay loam--------	CL, CL-ML	A-4, A-6	0	100	95-100	80-100	55-96	24-45	7-25
	34-50	Loam, clay loam	CL, CL-ML	A-6, A-7-6	0	100	95-100	95-100	55-84	26-45	7-25
	50-60	Loam, clay loam, clay.	CL, CL-ML	A-4, A-6, A-7-6	0	98-100	95-100	80-100	55-95	24-45	7-25
13---------- Chaney	0-16	Loamy fine sand	SM, SM-SC, SP-SM	A-2-4, A-4, A-3	0	80-100	80-100	65-98	7-45	<25	NP-4
	16-45	Clay, sandy clay	CL, CH	A-7-6	0	90-100	90-100	90-100	43-85	38-60	24-42
	45-60	Clay, sandy clay loam, sandy clay.	CL, CH, SC, SM-SC	A-6, A-7-6, A-2, A-4	0	90-100	90-100	80-100	25-85	25-60	6-40
14----------	0-6	Loamy fine sand	SM, SP-SM SM-SC	A-2-4	0	85-100	85-100	80-98	10-30	<22	NP-4
Decordova	6-80	Fine sandy loam, loam.	SM, SM-SC	A-2-4, A-4	0	90-100	90-100	80-98	15-40	<25	NP-7
15---------- Demona	0-26	Loamy sand-------	SM, SP-SM, SM-SC	A-2-4, A-4, A-3	0	80-100	75-100	60-98	7-45	<25	NP-5
	26-54	Sandy clay, clay	CH, CL, SC	A-7-6	0	80-100	80-100	80-100	41-85	33-60	20-40
	54-62	Sandy clay, clay, sandy clay loam.	CL, CH, SC	A-2-6, A-7-6, A-6	0	80-100	80-100	80-100	25-85	25-60	11-40
16---------- Eufaula	0-80	Loamy fine sand	SM, SP-SM	A-2, A-3	0	100	98-100	82-100	5-35	<20	NP
17---------- Frio	0-40	Clay loam--------	CL, CH	A-6, A-7	0-2	80-100	80-100	70-100	60-95	35-52	20-34
	40-60	Silty clay, clay loam, gravelly clay loam.	CL, CH	A-6, A-7	0-2	65-100	65-100	60-100	55-95	30-52	18-34
18---------- Frio	0-50	Clay loam--------	CL, CH	A-6, A-7	0-2	80-100	80-100	70-100	60-95	35-52	20-34
	50-60	Silty clay, clay loam, silty clay loam.	CL, CH	A-6, A-7	0-5	80-100	80-100	70-100	60-95	30-52	18-34
19---------- Hassee	0-10	Loam----------	CL	A-4, A-6	0	95-100	95-100	80-100	50-80	20-35	8-16
	10-45	Clay, silty clay	CH, CL	A-7-6	0	95-100	95-100	95-100	75-95	41-60	24-40
	45-60	Clay, clay loam	CH, CL	A-7-6, A-6	0	95-100	95-100	90-100	70-95	35-52	20-35
20---------- Hensley	0-6	Very stony clay loam.	CL, CL-ML, SM-SC, SC	A-4, A-6	20-50	80-100	75-100	55-95	36-85	20-40	5-20
	6-15	Clay, clay loam	CL, CH	A-6, A-7	0-10	80-100	75-100	70-100	60-95	35-55	18-35
	15-18	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
21, 22---------- Leeray	0-50	Clay----------	CH	A-7-6	0-5	95-100	95-100	85-100	75-95	49-70	30-45
	50-60	Clay, silty clay	CH, CL	A-7-6, A-6	0-5	95-100	95-100	85-100	70-95	33-60	19-40
23---------- Leeray	0-40	Clay----------	CH	A-7-6	0-5	95-100	95-100	85-100	75-95	49-70	30-45
	40-60	Clay, silty clay	CH, CL	A-7-6, A-6	0-5	95-100	95-100	85-100	70-95	33-60	19-40
24---------- Lindy	0-8	Clay loam--------	CL, CL-ML	A-4, A-6	0-3	95-100	90-100	80-100	65-90	20-40	5-20
	8-30	Clay loam, clay	CL, CH	A-6, A-7	0-3	95-100	95-100	90-100	65-90	35-60	15-35
	30-40	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
25---------- May	0-18	Very fine sandy loam.	SM, ML, CL-ML, SM-SC	A-4	0	95-100	95-100	80-100	40-60	<25	NP-7
	18-48	Sandy clay loam, clay loam.	SC, CL	A-6	0	95-100	95-100	80-100	40-75	25-40	12-25
	48-60	Sandy clay loam, fine sandy loam, loam.	SC, CL	A-4, A-6	0	95-100	95-100	75-100	40-75	20-40	8-25

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
26.* Dumps, mine											
27---------- Minwells	0-6	Fine sandy loam	CL, CL-ML, SC, SM-SC	A-4, A-6	0	90-100	85-100	60-90	36-60	18-30	5-15
	6-31	Clay, clay loam, sandy clay.	CL, CH	A-7-6	0	90-100	85-100	80-100	51-95	43-58	21-35
	31-57	Clay loam, sandy clay loam, gravelly sandy clay loam.	CL, SC	A-6, A-7-6, A-2-6, A-2-7	0	75-100	70-100	55-100	30-80	32-45	15-25
	57-80	Very gravelly sand, very gravelly sandy loam, gravelly sandy clay loam.	SC, GM, SP-SM, GP-GM	A-1, A-2	0-5	15-75	10-60	5-50	5-30	<44	NP-28
28---------- Minwells	0-10	Fine sandy loam	CL, CL-ML, SC, SM-SC	A-4, A-6	0	90-100	85-100	60-90	36-60	18-30	5-15
	10-30	Clay, clay loam, sandy clay.	CL, CH	A-7-6	0	90-100	85-100	80-100	51-95	43-58	21-35
	30-60	Very gravelly sand, very gravelly sandy loam, gravelly sandy clay loam.	SC, GM, SP-SM, GP-GM	A-1, A-2	0-5	15-75	10-60	5-50	5-30	<44	NP-28
29---------- Minwells	0-6	Fine sandy loam	CL, CL-ML, SC, SM-SC	A-4, A-6	0	90-100	85-100	60-90	36-60	18-30	5-15
	6-60	Clay, clay loam, sandy clay.	CL, CH	A-7-6	0	90-100	85-100	80-100	51-95	43-58	21-35
30---------- Owens	0-8	Clay----------	CL, CH	A-7-6	0-5	95-100	95-100	85-100	75-95	45-60	22-32
	8-18	Clay, clay loam, silty clay.	CL, CH	A-7-6	0-5	95-100	90-100	85-100	75-95	45-60	22-32
	18-40	Weathered bedrock, very shaly clay, shaly clay.	CL, CH	A-7-6	0-5	90-100	85-100	80-100	55-95	40-55	25-35
31---------- Owens	0-4	Very stony clay	CL, CH	A-7-6	15-35	80-100	75-100	65-100	60-95	45-60	22-32
	4-12	Clay, clay loam, silty clay.	CL, CH	A-7-6	0-10	90-100	85-100	80-100	75-95	45-60	22-32
	12-20	Weathered bedrock, very shaly clay, shaly clay.	CL, CH	A-7-6	0-10	90-100	85-100	80-100	55-95	40-55	25-35
32---------- Owens	0-4	Very stony clay	CL, CH	A-7-6	15-35	80-100	75-100	65-100	60-95	45-60	22-32
	4-16	Clay, clay loam, silty clay.	CL, CH	A-7-6	0-10	90-100	85-100	80-100	75-95	45-60	22-32
	16-40	Weathered bedrock, very shaly clay, shaly clay.	CL, CH	A-7-6	0-10	90-100	85-100	80-100	55-95	40-55	25-35
33---------- Palopinto	0-4	Extremely stony clay loam.	CH, CL	A-7-6, A-6	10-40	85-100	85-100	75-100	70-95	40-58	23-38
	4-12	Extremely stony clay loam, extremely stony silty clay loam, extremely stony loam.	CH, CL	A-7-6, A-6	50-85	65-100	65-100	60-100	51-95	40-58	23-38
	12-14	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
34---------- Patilo	0-45	Fine sand--------	SM, SP-SM, SM-SC	A-2-4, A-3	0	100	95-100	85-100	8-28	<25	NP-5
	45-55	Sandy clay loam, fine sandy loam.	SC	A-2, A-4, A-6	0	90-100	90-100	90-100	25-50	22-36	8-20
35---------- Santo	0-8	Fine sandy loam	SM, SC, ML, CL	A-4	0	100	95-100	90-100	36-85	15-30	NP-10
	8-80	Fine sandy loam, loam, loamy fine sand.	SM, SC, ML, CL	A-2-4, A-4	0	100	95-100	90-100	15-85	15-30	NP-10
36---------- Set	0-10	Clay----------	CL, CH	A-7-6	0-5	90-100	85-100	80-100	75-95	41-60	20-35
	10-42	Clay, silty clay, silty clay loam.	CL, CH	A-6, A-7-6	0-5	90-100	85-100	80-100	75-95	36-60	20-35
	42-50	Shaly clay-------	CL, CH	A-6, A-7-6	0	90-100	85-100	80-100	75-95	36-60	16-35
37---------- Set	0-12	Clay----------	CL, CH	A-7-6	0-5	90-100	85-100	80-100	75-95	41-60	20-35
	12-50	Clay, silty clay, silty clay loam.	CL, CH	A-6, A-7-6	0-5	90-100	85-100	80-100	75-95	36-60	20-35
	50-60	Shaly clay-------	CL, CH	A-6, A-7-6	0	90-100	85-100	80-100	75-95	36-60	16-35
38:*											
Set----------	0-12	Extremely stony clay.	CL, CH	A-7-6	40-60	85-100	85-100	80-100	75-95	41-60	20-35
	12-44	Clay, silty clay, silty clay loam.	CL, CH	A-6, A-7-6	0-5	85-100	85-100	80-100	75-95	36-60	20-35
	44-60	Shaly clay-------	CL, CH	A-6, A-7-6	0	85-100	85-100	80-100	75-95	36-60	16-35
Palopinto-------	0-4	Extremely stony clay loam.	CH, CL	A-7-6, A-6	10-40	85-100	85-100	75-100	70-95	30-58	20-38
	4-12	Extremely stony clay loam, extremely stony silty clay loam, extremely stony loam.	CH, CL	A-7-6, A-6	50-85	65-100	65-100	60-100	51-95	30-58	20-38
	12-14	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
39---------- Shatruce	0-14	Very bouldery sandy loam.	SM, SM-SC	A-2-4, A-4	15-50	70-95	50-85	45-75	25-40	15-25	2-7
	14-34	Clay, sandy clay, clay loam.	CL	A-7-6, A-6	0-5	80-100	80-100	80-100	51-80	36-47	25-35
	34-60	Shaly clay-------	CL	A-6, A-7-6	0-5	80-100	80-100	80-100	51-80	31-45	20-30
40---------- Shavash	0-10	Stony loamy fine sand.	SM, SM-SC, SP-SM	A-2-4, A-4, A-1-B	0-20	75-100	70-100	40-90	10-40	<25	NP-6
	10-16	Sandy clay loam, clay loam.	CL, SC	A-2-6, A-6	0-2	80-100	75-100	60-100	26-75	25-35	11-20
	16-18	Weathered bedrock	---	---	---	---	---	---	---	---	---
41---------- Thurber	0-6	Clay loam--------	CL	A-4, A-6	0	95-100	95-100	90-100	60-90	25-35	8-20
	6-45	Clay, clay loam	CL, CH	A-7-6	0	95-100	95-100	90-100	70-95	41-65	25-45
	45-60	Clay, clay loam	CL	A-6, A-7-6	0	95-100	85-100	75-100	50-85	35-50	20-35
42---------- Thurber	0-8	Clay loam--------	CL	A-4, A-6	0	95-100	95-100	90-100	60-90	25-40	8-20
	8-36	Clay, clay loam	CL, CH	A-7-6, A-6	0	95-100	95-100	90-100	70-95	37-65	22-45
	36-72	Clay, clay loam	CL	A-6, A-7-6	0	95-100	85-99	75-97	50-85	35-50	20-35

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
43---------- Truce	0-7	Fine sandy loam	CL-ML, SM-SC, SM, SC	A-4	0	75-100	75-100	70-100	40-75	20-30	3-10
	7-48	Clay, sandy clay, clay loam.	CL, CH	A-6, A-7	0	80-100	80-100	80-100	60-85	35-52	20-34
	48-60	Very shaly clay, shaly clay.	CL, CH	A-6, A-7	0	80-100	80-100	80-100	60-95	35-52	20-34
44---------- Truce	0-8	Fine sandy loam	CL-ML, SM-SC, SM, SC	A-4	0	75-100	75-100	70-100	40-75	20-30	3-10
	8-45	Clay, sandy clay, clay loam.	CL, CH	A-6, A-7	0	80-100	80-100	80-100	60-85	35-52	20-34
	45-60	Very shaly clay, shaly clay.	CL, CH	A-6, A-7	0	80-100	80-100	80-100	60-95	35-52	20-34
45---------- Truce	0-3	Fine sandy loam	CL-ML, SM-SC, SM, SC	A-4	0	75-100	75-100	70-100	40-75	20-30	3-10
	3-44	Clay, sandy clay, clay loam.	CL, CH	A-6, A-7	0	80-100	80-100	80-100	60-85	35-52	20-34
	44-60	Very shaly clay, shaly clay.	CL, CH	A-6, A-7	0	80-100	80-100	80-100	60-95	35-52	20-34
46:*											
Truce----------	0-6	Extremely stony fine sandy loam.	SC, CL-ML, SM, SM-SC	A-4	40-65	75-100	75-100	70-100	36-70	20-30	3-10
	6-44	Clay, sandy clay, clay loam.	CL, CH	A-6, A-7	0-5	80-100	80-100	80-100	60-85	35-52	20-34
	44-60	Very shaly clay, shaly clay.	CL, CH	A-6, A-7	0-5	80-100	80-100	80-100	60-95	35-52	20-34
Bonti----------	0-5	Extremely stony fine sandy loam.	SM, SM-SC, ML, CL-ML	A-2-4, A-4	45-65	80-100	80-100	70-98	25-70	18-30	2-7
	5-26	Clay, sandy clay, clay loam.	CL	A-6, A-7	0-15	80-100	80-100	75-100	55-75	30-45	18-25
	26-27	Weathered bedrock	---	---	---	---	---	---	---	---	---
47---------- Vashti	0-16	Loamy fine sand	SM, SM-SC	A-2-4	0-2	90-100	90-100	60-95	15-35	<25	NP-6
	16-34	Sandy clay loam, clay loam.	SC, CL	A-6	0-2	90-100	90-100	65-95	36-55	25-35	11-20
	34-36	Weathered bedrock	---	---	---	---	---	---	---	---	---
48---------- Velow	0-10	Clay loam--------	CL, CL-ML	A-4, A-6	0	100	95-100	85-100	50-80	20-40	5-20
	10-36	Loam, clay loam, sandy clay loam.	CL, CL-ML	A-4, A-6	0	95-100	95-100	85-100	50-80	20-40	5-20
	36-60	Loam, clay loam, sandy clay loam.	CL, CL-ML, SC, SM-SC	A-4, A-6	0	80-100	70-100	65-100	40-80	20-40	5-20
49---------- Velow	0-16	Clay loam--------	CL, CL-ML	A-4, A-6	0	100	95-100	85-100	50-80	20-40	5-20
	16-30	Loam, clay loam, sandy clay loam.	CL, CL-ML	A-4, A-6	0	95-100	95-100	85-100	50-80	20-40	5-20
	30-60	Loam, clay loam, sandy clay loam.	CL, CL-ML, SC, SM-SC	A-4, A-6	0	80-100	70-100	65-100	40-80	20-40	5-20
50---------- Wichita	0-8	Clay loam--------	CL	A-6, A-4	0	98-100	98-100	90-100	60-80	25-36	8-18
	8-35	Clay loam, clay	CL	A-6, A-7-6	0	95-100	95-100	95-100	70-95	36-50	18-32
	35-60	Clay loam, clay	CL	A-6, A-7-6, A-4	0	95-100	90-100	85-100	70-85	25-45	8-28

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
51---------- Windthorst	0-10	Fine sandy loam	SM, SM-SC, CL-ML, ML	A-4	0	95-100	90-100	75-100	36-75	<28	NP-7
	10-55	Clay, sandy clay, clay loam.	CL, CH	A-6, A-7-6	0	95-100	95-100	85-100	51-90	35-53	20-35
	55-60	Sandy clay loam, clay, fine sandy loam.	SC, CL	A-4, A-6, A-7-6	0	85-100	80-100	75-100	36-90	25-45	8-28
52:*											
Yahola----------	0-8	Very fine sandy loam.	ML, CL-ML	A-4	0	100	100	95-100	65-85	22-29	2-7
	8-45	Fine sandy loam, loam, very fine sandy loam.	SM, ML, CL-ML, SM-SC	A-4	0	100	95-100	90-100	36-85	<26	NP-7
	45-62	Stratified clay loam to loamy fine sand.	SM, ML, CL-ML, SM-SC	A-2, A-4	0	100	95-100	90-100	15-85	<26	NP-7
Gaddy----------	0-6	Loamy fine sand	SM	A-2	0	100	98-100	90-100	15-35	---	NP-3
	6-62	Loamy fine sand, fine sand.	SM	A-2	0	100	98-100	90-100	15-35	---	NP-4

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS

[The symbol < means less than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Map symbol and soil name	Depth	Clay <2mm	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	G/cm3	In/hr	In/in	pH					Pct
1----------	0-28	7-18	1.35-1.50	0.6-2.0	0.13-0.20	6.1-7.8	Low----------	0.37	5	5	0.5-2
Apalo	28-80	7-18	1.35-1.50	0.6-2.0	0.13-0.20	7.4-8.4	Low----------	0.37			
2, 3----------	0-30	7-18	1.35-1.50	0.6-2.0	0.13-0.20	6.1-7.8	Low----------	0.37	5	5	0.5-2
Apalo	30-60	7-18	1.35-1.50	0.6-2.0	0.13-0.20	7.4-8.4	Low----------	0.37			
4----------	0-15	3-12	---	2.0-6.0	0.07-0.11	5.6-7.3	Very low-----	0.37	5	2	<1
Bastrop	15-65	20-35	1.55-1.65	0.6-2.0	0.15-0.19	5.6-8.4	Low----------	0.32			
5----------	0-13	10-20	1.50-1.75	2.0-6.0	0.11-0.17	5.6-7.3	Low----------	0.37	5	3	0.5-1
Bastrop	13-80	20-35	1.55-1.65	0.6-2.0	0.15-0.19	5.6-8.4	Low----------	0.32			
6----------	0-15	10-20	1.50-1.75	2.0-6.0	0.11-0.17	5.6-7.3	Low----------	0.37	5	3	0.5-1
Bastrop	15-70	20-35	1.55-1.65	0.6-2.0	0.15-0.19	5.6-8.4	Low----------	0.32			
7----------	0-4	10-20	1.50-1.75	2.0-6.0	0.11-0.17	5.6-7.3	Low----------	0.37	5	3	0.5-1
Bastrop	4-65	20-35	1.55-1.65	0.6-2.0	0.15-0.19	5.6-8.4	Low----------	0.32			
8----------	0-18	---	---	0.6-2.0	0.15-0.20	6.1-7.8	Moderate-----	0.32	5	---	1-3
Blanket	18-32	---	---	0.2-0.6	0.12-0.18	6.1-8.4	Moderate-----	0.37			
	32-60	---	---	0.6-2.0	0.12-0.18	7.9-8.4	Moderate-----	0.43			
9----------	0-9	10-20	---	0.6-2.0	0.11-0.15	5.6-7.3	Low----------	0.37	2	3	<2
Bonti	9-36	35-50	---	0.2-0.6	0.15-0.20	5.1-6.0	Moderate-----	0.32			
	36-38	---	---	---	---	---	----------	----			
10----------	0-11	10-20	---	0.6-2.0	0.11-0.15	5.6-7.3	Low----------	0.37	2	3	<2
Bonti	11-32	35-50	---	0.2-0.6	0.15-0.20	5.1-6.0	Moderate-----	0.32			
	32-34	---	---	---	---	---	----------	----			
11:*											
Bonti----------	0-5	7-20	---	0.6-2.0	0.08-0.12	5.6-7.3	Low----------	0.32	2	8	---
	5-24	35-50	---	0.2-0.6	0.15-0.20	5.1-6.0	Moderate-----	0.32			
	24-26	---	---	---	---	---	----------	----			
Exray----------	0-5	7-22	---	0.6-2.0	0.08-0.14	6.1-7.3	Low----------	0.32	1	8	---
	5-16	35-50	---	0.2-0.6	0.12-0.20	5.6-6.5	Moderate-----	0.32			
	16-17	---	---	---	---	---	----------	----			
12----------	0-34	20-35	---	0.6-2.0	0.15-0.20	7.4-8.4	Low----------	0.28	5	4L	1-4
Bosque	34-50	20-35	---	0.6-2.0	0.15-0.20	7.4-8.4	Low----------	0.28			
	50-60	20-45	---	0.6-2.0	0.11-0.18	7.9-8.4	Low----------	0.28			
13----------	0-16	5-15	1.72-1.87	2.0-6.0	0.05-0.10	5.6-7.3	Very low-----	0.20	5	2	0.5-1
Chaney	16-45	35-50	1.42-1.72	0.06-0.2	0.15-0.18	5.6-7.3	Moderate-----	0.28			
	45-60	20-45	1.54-1.82	0.06-0.2	0.15-0.18	5.6-7.8	Moderate-----	0.28			
14----------	0-6	5-12	---	2.0-6.0	0.07-0.11	5.6-7.3	Very low-----	0.20	5	2	<1
Decordova	6-80	6-17	---	2.0-6.0	0.10-0.16	5.6-8.4	Low----------	0.24			
15----------	0-26	5-15	---	2.0-6.0	0.05-0.10	5.6-7.8	Very low-----	0.17	5	2	<1
Demona	26-54	35-50	---	0.2-0.6	0.15-0.18	5.1-6.5	Moderate-----	0.24			
	54-62	20-45	---	0.2-0.6	0.14-0.18	5.1-6.5	Moderate-----	0.24			
16----------	0-80	2-10	1.35-1.70	6.0-20	0.05-0.11	5.1-7.3	Low----------	0.17	5	2	0.5-1
Eufaula											
17----------	0-40	35-50	---	0.2-0.6	0.15-0.22	7.9-8.4	Moderate-----	0.32	5	4	1-4
Frio	40-60	35-50	---	0.2-0.6	0.11-0.22	7.9-8.4	Moderate-----	0.32			
18----------	0-50	35-50	---	0.2-0.6	0.15-0.22	7.9-8.4	Moderate-----	0.32	5	4	1-4
Frio	50-60	35-50	---	0.2-0.6	0.11-0.22	7.9-8.4	Moderate-----	0.32			

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Map symbol and soil name	Depth	Clay <2mm	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	G/cm³	In/hr	In/in	pH					Pct
19----------	0-10	10-20	---	0.6-2.0	0.11-0.20	6.1-7.3	Low----------	0.43	5	5	<2
Hassee	10-45	45-60	---	<0.06	0.12-0.18	6.1-8.4	High---------	0.32			
	45-60	35-60	---	<0.06	0.12-0.20	6.6-8.4	High---------	0.32			
20----------	0-6	15-30	---	0.2-0.6	0.08-0.16	6.1-7.8	Low----------	0.32	1	8	---
Hensley	6-15	35-55	---	0.06-0.2	0.10-0.20	6.6-8.4	Moderate-----	0.43			
	15-18	---	---	---	---	---	----------	----			
21, 22----------	0-50	40-60	---	<0.06	0.12-0.18	7.9-8.4	Very high----	0.32	5	---	1-3
Leeray	50-60	40-60	---	<0.06	0.10-0.15	7.9-8.4	Very high----	0.32			
23----------	0-40	40-60	---	<0.06	0.12-0.18	7.9-8.4	Very high----	0.32	5	---	1-3
Leeray	40-60	40-60	---	<0.06	0.10-0.15	7.9-8.4	Very high----	0.32			
24----------	0-8	20-35	---	0.6-2.0	0.12-0.20	6.1-7.8	Low----------	0.32	2	---	0.5-2
Lindy	8-30	35-60	---	0.06-0.2	0.10-0.20	6.1-7.8	Moderate-----	0.32			
	30-40	---	---	---	---	---	----------	----			
25----------	0-18	8-18	---	2.0-6.0	0.11-0.15	6.1-7.8	Low----------	0.37	5	---	<1
May	18-48	20-30	---	0.6-2.0	0.12-0.20	6.6-7.8	Moderate-----	0.37			
	48-60	10-30	---	0.6-2.0	0.11-0.20	7.4-8.4	Moderate-----	0.37			
26.* Dumps, mine											
27----------	0-6	10-20	---	2.0-6.0	0.10-0.15	6.1-7.8	Low----------	0.24	5	3	<1
Minwells	6-31	35-45	---	0.06-0.2	0.12-0.18	6.1-7.3	Moderate-----	0.32			
	31-57	20-35	---	0.2-0.6	0.10-0.18	6.6-8.4	Moderate-----	0.32			
	57-80	3-20	---	2.0-6.0	0.01-0.09	7.4-8.4	Low----------	0.15			
28----------	0-10	10-20	---	2.0-6.0	0.10-0.15	6.1-7.8	Low----------	0.24	5	3	<1
Minwells	10-30	35-45	---	0.06-0.2	0.12-0.18	6.1-7.3	Moderate-----	0.32			
	30-60	3-20	---	2.0-6.0	0.01-0.09	7.4-8.4	Low----------	0.15			
29----------	0-6	10-20	---	2.0-6.0	0.10-0.15	6.1-7.8	Low----------	0.24	5	3	<1
Minwells	6-60	35-45	---	0.06-0.2	0.12-0.18	6.1-7.3	Moderate-----	0.32			
30----------	0-8	35-60	---	<0.06	0.13-0.17	7.9-8.4	High---------	0.32	1	4	<2
Owens	8-18	35-60	---	<0.06	0.13-0.17	7.9-8.4	High---------	0.32			
	18-40	40-60	---	<0.06	0.03-0.08	7.9-8.4	High---------	0.37			
31----------	0-4	35-60	---	<0.06	0.10-0.17	7.9-8.4	High---------	0.28	1	8	---
Owens	4-12	35-60	---	<0.06	0.13-0.17	7.9-8.4	High---------	0.32			
	12-20	35-60	---	<0.06	0.03-0.08	7.9-8.4	High---------	0.37			
32----------	0-4	35-60	---	<0.06	0.10-0.17	7.9-8.4	High---------	0.28	1	8	---
Owens	4-16	35-60	---	<0.06	0.13-0.17	7.9-8.4	High---------	0.32			
	16-40	35-60	---	<0.06	0.03-0.08	7.9-8.4	High---------	0.37			
33----------	0-4	18-35	---	0.6-2.0	0.10-0.15	6.1-8.4	Moderate-----	0.10	1	---	---
Palopinto	4-12	18-35	---	0.6-2.0	0.10-0.15	6.1-8.4	Moderate-----	0.10			
	12-14	---	---	---	---	---	----------	----			
34----------	0-45	2-15	---	6.0-20	0.05-0.08	5.6-7.3	Very low-----	0.17	5	1	0.5-2
Patilo	45-65	18-35	---	0.2-0.6	0.14-0.18	5.1-6.5	Low----------	0.24			
35----------	0-8	10-18	---	2.0-6.0	0.11-0.17	7.4-8.4	Low----------	0.28	5	---	0.5-2
Santo	8-80	5-18	---	2.0-6.0	0.07-0.17	7.4-8.4	Low----------	0.28			
36----------	0-10	40-55	1.4-1.5	0.06-0.2	0.12-0.18	7.9-8.4	Moderate-----	0.32	4	---	1-3
Set	10-42	35-55	1.4-1.5	0.06-0.2	0.12-0.20	7.9-8.4	Moderate-----	0.37			
	42-50	20-55	1.4-1.6	<0.06	0.12-0.18	7.9-8.4	Moderate-----	----			
37----------	0-12	40-55	1.4-1.5	0.06-0.2	0.12-0.18	7.9-8.4	Moderate-----	0.32	4	---	1-3
Set	12-50	35-55	1.4-1.5	0.06-0.2	0.12-0.20	7.9-8.4	Moderate-----	0.37			
	50-60	20-55	1.4-1.6	<0.06	0.12-0.18	7.9-8.4	Moderate-----	----			

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Map symbol and soil name	Depth	Clay <2mm	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	G/cm3	In/hr	In/in	pH					Pct
38:*											
Set	0-12	40-55	1.4-1.5	0.06-0.2	0.12-0.18	7.9-8.4	Moderate	0.32	4	8	---
	12-44	35-55	1.4-1.5	0.06-0.2	0.12-0.20	7.9-8.4	Moderate	0.37			
	44-60	20-55	1.4-1.6	<0.06	0.12-0.18	7.9-8.4	Moderate	---			
Palopinto	0-4	18-35	---	0.6-2.0	0.10-0.15	6.1-8.4	Low	0.10	1	8	---
	4-12	18-35	---	0.6-2.0	0.10-0.15	6.1-8.4	Low	0.10			
	12-14	---	---	---	---	---	---	---			
39	0-14	6-18	---	2.0-6.0	0.08-0.13	5.6-6.5	Low	0.24	3	8	---
Shatruce	14-34	35-50	---	0.06-0.6	0.14-0.18	4.5-6.5	Moderate	0.32			
	34-60	35-50	---	<0.06	0.06-0.10	4.5-6.5	Moderate	---			
40	0-10	5-15	---	2.0-6.0	0.04-0.10	6.1-7.3	Low	0.37	1	2	<1
Shavash	10-16	20-35	---	0.6-2.0	0.12-0.20	5.6-5.5	Moderate	0.28			
	16-18	---	---	---	---	---	---	---			
41	0-6	20-35	---	0.2-0.6	0.15-0.22	6.1-7.8	Moderate	0.43	5	---	<1.5
Thurber	6-45	35-55	---	<0.06	0.12-0.18	6.6-8.4	High	0.32			
	45-60	25-40	---	<0.06	0.12-0.18	7.4-8.4	High	0.32			
42	0-8	20-35	---	0.2-0.6	0.15-0.22	6.1-7.8	Moderate	0.43	5	---	<1.5
Thurber	8-36	35-55	---	<0.06	0.12-0.18	6.6-8.4	High	0.32			
	36-72	25-40	---	<0.06	0.12-0.18	7.4-8.4	High	0.32			
43	0-7	8-20	1.52-1.62	0.6-2.0	0.07-0.12	5.6-7.3	Low	0.32	3	3	<2
Truce	7-48	35-55	1.59-1.69	0.06-0.2	0.07-0.13	6.1-8.4	Moderate	0.32			
	48-60	35-55	1.69-1.80	<0.06	0.05-0.09	6.6-8.4	Moderate	0.28			
44	0-8	8-20	1.52-1.62	0.6-2.0	0.07-0.12	5.6-7.3	Low	0.32	3	3	<2
Truce	8-45	35-55	1.59-1.69	0.06-0.2	0.07-0.13	6.1-8.4	Moderate	0.32			
	45-60	35-55	1.69-1.80	<0.06	0.05-0.09	6.6-8.4	Moderate	0.28			
45	0-3	8-20	1.52-1.62	0.6-2.0	0.07-0.12	5.6-7.3	Low	0.32	3	3	<2
Truce	3-44	35-55	1.59-1.69	0.06-0.2	0.07-0.13	6.1-8.4	Moderate	0.32			
	44-60	35-55	1.69-1.80	<0.06	0.05-0.09	6.6-8.4	Moderate	0.28			
46:*											
Truce	0-6	8-20	1.52-1.62	0.6-2.0	0.05-0.10	5.6-7.3	Low	0.24	3	8	---
	6-44	35-55	1.59-1.69	0.06-0.2	0.07-0.13	6.1-8.4	Moderate	0.32			
	44-60	35-55	1.69-1.80	<0.06	0.05-0.09	6.6-8.4	Moderate	0.28			
Bonti	0-5	7-20	---	0.6-2.0	0.08-0.12	5.6-7.3	Low	0.28	2	8	---
	5-26	35-50	---	0.2-0.6	0.15-0.20	5.1-6.0	Moderate	0.32			
	26-27	---	---	---	---	---	---	---			
47	0-16	3-15	---	2.0-6.0	0.06-0.11	6.1-7.3	Low	0.24	2	2	<1
Vashti	16-34	20-35	---	0.6-2.0	0.12-0.20	5.6-7.3	Low	0.28			
	34-36	---	---	---	---	---	---	---			
48	0-10	18-35	---	0.6-2.0	0.15-0.20	6.6-7.8	Low	0.28	5	---	1-3
Velow	10-36	18-35	---	0.6-2.0	0.15-0.20	6.6-8.4	Low	0.28			
	36-60	18-35	---	0.6-2.0	0.12-0.18	7.9-8.4	Low	0.28			
49	0-16	18-35	---	0.6-2.0	0.15-0.20	6.6-7.8	Low	0.28	5	---	1-3
Velow	16-30	18-35	---	0.6-2.0	0.15-0.20	6.6-8.4	Low	0.28			
	30-60	18-35	---	0.6-2.0	0.12-0.18	7.9-8.4	Low	0.28			
50	0-8	22-35	---	0.6-2.0	0.15-0.20	6.6-7.8	Moderate	0.32	5	6	<2
Wichita	8-35	35-45	---	0.2-0.6	0.15-0.20	6.6-8.4	Moderate	0.32			
	35-60	35-45	---	0.2-0.6	0.12-0.18	7.9-8.4	Moderate	0.32			
51	0-10	5-18	1.48-1.60	0.6-2.0	0.12-0.17	5.6-7.3	Low	0.49	5	3	<1
Windthorst	10-55	35-50	1.45-1.55	0.2-0.6	0.15-0.20	5.6-7.3	Moderate	0.37			
	55-60	15-45	1.47-1.58	0.2-0.6	0.12-0.20	5.6-8.4	Moderate	0.37			

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Map symbol and soil name	Depth	Clay <2mm	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	G/cm^3	In/hr	In/in	pH					Pct
52:*											
Yahola	0-8	10-18	1.30-1.55	2.0-6.0	0.15-0.20	7.4-8.4	Low	0.32	5	4	0.5-1
	8-45	5-18	1.40-1.70	2.0-6.0	0.11-0.20	7.9-8.4	Low	0.20			
	45-62	2-30	1.45-1.75	2.0-6.0	0.07-0.20	7.9-8.4	Low	0.20			
Gaddy	0-6	---	---	6.0-20	0.07-0.11	7.4-8.4	Low	0.17	5	2	---
	6-62	---	---	6.0-20	0.06-0.10	7.9-8.4	Low	0.17			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--SOIL AND WATER FEATURES

[The definitions of "flooding" and "water table" in the text explain terms such as "rare," "brief," "apparent," and "perched." The symbol > means more than. Absence of an entry indicates that the feature is not a concern]

Map symbol and soil name	Hydrologic group	Flooding			High water table			Bedrock		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness	Uncoated steel	Concrete
					Ft			In			
1, 2, 3---------- Apalo	B	None---------	---	---	>6.0	---	---	>60	---	Low------	Low.
4, 5, 6, 7-------- Bastrop	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Low.
8---------- Blanket	C	None---------	---	---	>6.0	---	---	>60	---	High-----	Low.
9, 10---------- Bonti	C	None---------	---	---	>6.0	---	---	20-40	Hard	High-----	Moderate.
11:* Bonti----------	C	None---------	---	---	>6.0	---	---	20-40	Hard	High-----	Moderate.
Exray----------	D	None---------	---	---	>6.0	---	---	10-20	Hard	High-----	Moderate.
12---------- Bosque	B	Occasional	Brief-----	Oct-May	>6.0	---	---	>60	---	High-----	Low.
13---------- Chaney	C	None---------	---	---	>6.0	---	---	>60	---	High-----	Moderate.
14---------- Decordova	B	None---------	---	---	>6.0	---	---	>60	---	Low------	Low.
15---------- Demona	C	None---------	---	---	1.5-3.5	Perched	May-Oct	>60	---	High-----	Moderate.
16---------- Eufaula	A	None---------	---	---	>6.0	---	---	>60	---	Low------	Moderate.
17---------- Frio	B	Occasional	Brief-----	Oct-May	>6.0	---	---	>60	---	High-----	Low.
18---------- Frio	B	Frequent----	Brief-----	Oct-May	>6.0	---	---	>60	---	High-----	Low.
19---------- Hassee	D	None---------	---	---	1.0-2.0	Perched	May-Oct	>60	---	High-----	Low.
20---------- Hensley	D	None---------	---	---	>6.0	---	---	10-20	Hard	High-----	Low.
21, 22, 23-------- Leeray	D	None---------	---	---	>6.0	---	---	>60	---	High-----	Low.
24---------- Lindy	C	None---------	---	---	>6.0	---	---	24-40	Hard	High-----	Low.
25---------- May	B	None---------	---	---	>6.0	---	---	>60	---	High-----	Low.
26.* Dumps, mine											
27, 28, 29-------- Minwells	C	None---------	---	---	>6.0	---	---	>60	---	High-----	Low.
30, 31, 32-------- Owens	D	None---------	---	---	>6.0	---	---	>60	---	High-----	Low.
33---------- Palopinto	D	None---------	---	---	>6.0	---	---	6-20	Hard	High-----	Low.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Map symbol and soil name	Hydrologic group	Flooding			High water table			Bedrock		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness	Uncoated steel	Concrete
					Ft			In			
34---------- Patilo	B	None--------	---	---	4.0-6.0	Perched	Oct-May	>60	---	High-----	Moderate.
35---------- Santo	B	Frequent----	Very brief	Apr-Jun	>6.0	---	---	>60	---	Low------	Low.
36, 37---------- Set	C	None--------	---	---	>6.0	---	---	>60	---	High-----	Low.
38:*											
Set----------	C	None--------	---	---	>6.0	---	---	>60	---	High-----	Low.
Palopinto----	D	None--------	---	---	>6.0	---	---	4-20	Hard	High-----	Low.
39---------- Shatruce	C	None--------	---	---	>6.0	---	---	>60	---	High-----	Moderate.
40---------- Shavash	C	None--------	---	---	>6.0	---	---	10-20	Hard	Moderate	Low.
41, 42---------- Thurber	D	None--------	---	---	>6.0	---	---	>60	---	High-----	Low.
43, 44, 45---- Truce	C	None--------	---	---	>6.0	---	---	>60	---	High-----	Low.
46:*											
Truce----------	C	None--------	---	---	>6.0	---	---	>60	---	High-----	Low.
Bonti----------	C	None--------	---	---	>6.0	---	---	20-40	Hard	High-----	Moderate.
47---------- Vashti	C	None--------	---	---	>6.0	---	---	20-40	Hard	High-----	Moderate.
48, 49---------- Velow	B	None--------	---	---	>6.0	---	---	>60	---	High-----	Low.
50---------- Wichita	C	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low.
51---------- Windthorst	C	None--------	---	---	>6.0	---	---	>60	---	High-----	Low.
52:*											
Yahola----------	B	Occasional	Very brief	Mar-Aug	>6.0	---	---	>60	---	Low------	Low.
Gaddy----------	A	Occasional	Very brief	Mar-Aug	>6.0	---	---	>60	---	Low------	Low.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--PHYSICAL PROPERTIES OF SELECTED SOILS

Soil series and sample numbers	Depth	Horizon	Particle size distribution (Percent less than 2 mm)								Bulk density field moist	Water content	
			Sand						Silt (0.05-0.002)	Clay <0.002		1/3 bar	15 bar
			Very coarse (2.0-1.0)	Coarse (1.0-0.5)	Medium (0.5-0.25	Fine (0.25-0.1)	Very fine (0.1-0.05)	Total (2.0-0.05)					
	Cm										G/cc	--Pct (wt)--	
Bastrop:	0-25	Ap	0.3	3.4	10.1	29.6	32.5	75.9	18.5	5.6	1.5	---	2.1
Sample no.	25-33	A1	0.2	2.8	8.6	26.8	34.1	72.5	19.3	8.2	1.70	8.9	3.2
S74-TX-	33-51	B21t	0.4	2.2	6.2	18.6	27.7	55.1	22.9	22.0	1.57	17.6	8.4
363-4	51-76	B22t	0.4	2.2	5.3	17.7	26.9	52.5	25.1	22.4	1.56	15.7	8.4
	76-127	B23t	0.2	2.2	5.0	20.4	26.0	53.8	20.3	25.9	1.59	16.5	10.1
	127-183	B24t	0.5	2.2	5.3	17.7	26.3	52.0	22.0	26.0	1.6	---	10.2
	183-203	B3ca	0.7	2.6	6.0	15.4	30.7	55.4	25.1	19.5	1.61	14.7	7.8
Decordova:	0-15	Ap	*	2.5	11.5	44.6	27.0	85.6	11.8	2.6	1.50	---	1.6
Sample no.	15-36	B21t	*	2.1	10.6	42.1	24.2	79.0	13.9	7.1	1.72	8.7	3.2
S76-TX-	36-58	B22t	*	2.6	12.9	40.9	20.8	77.2	14.9	7.9	1.54	14.6	3.3
363-2	58-84	B23t	*	1.8	9.8	37.5	25.8	74.9	17.0	8.1	1.55	11.6	3.3
	84-124	B24t	0.1	1.9	9.9	39.9	25.1	76.9	15.5	7.6	1.60	11.0	3.1
	124-203	B3t	0.2	2.0	10.0	44.5	24.5	81.2	12.5	6.3	1.57	8.5	2.6
Minwells:	0-15	Ap	1.6	5.7	9.3	16.1	30.2	62.9	24.0	13.1	1.5	---	5.4
Sample no.	15-44	B21t	1.4	2.4	3.2	6.9	21.5	35.4	22.7	41.9	1.53	22.7	16.0
S74-TX-	44-79	B22t	1.0	2.1	3.4	8.1	26.1	40.7	25.4	33.9	1.62	20.2	13.5
363-1	79-118	B23t	.5	2.2	3.5	8.8	27.7	42.7	27.8	29.5	1.6	---	12.3
	118-144	B31ca	1.3	3.4	5.8	10.4	28.8	49.7	27.3	23.0	1.52	18.8	9.8
	144-179	IIB32ca	11.4	13.3	17.5	11.6	13.3	67.1	13.2	19.7	1.54	18.5	8.4
	179-203	IIC1ca	26.2	21.4	13.7	10.5	8.3	80.1	11.3	8.6	1.6	---	3.6
	203-223	IIC2ca	9.0	34.2	29.2	17.6	3.5	93.5	3.5	3.0	1.6	---	1.3
Apalo:	0-20	Ap	*	0.2	0.3	8.1	47.3	55.9	34.6	9.5	---	---	4.4
Sample no.	20-48	A1	*	0.1	0.4	7.9	45.7	54.1	33.6	12.3	---	---	5.4
S74-TX-	48-71	B21	*	0.2	0.5	7.5	46.7	54.9	34.1	11.0	---	---	4.7
363-5	71-132	B22	*	0.1	0.4	5.8	47.5	53.8	35.4	10.8	---	---	4.6
	132-188	B3ca	0.1	0.1	0.3	3.8	42.9	47.2	41.7	11.1	---	---	5.1

*Trace.

TABLE 18.--CHEMICAL PROPERTIES OF SELECTED SOILS

Soil series and sample numbers	Depth	Horizon	Extractable bases					Extractable acidity	Cation exchange capacity	Base saturation	Organic carbon	pH	
			Ca	Mg	Na	K	Sum					H_2O (1:1)	$CaCl_2$ 0.01M (1:2)
	Cm		Meq/100g							Pct	Pct		
Bastrop:	0-25	Ap	1.6	0.5	0.1	0.5	2.7	1.5	4.2	64	0.27	6.1	5.2
Sample no.	25-33	A1	2.9	0.7	0.2	0.4	4.2	1.6	5.8	72	0.26	6.4	5.6
S76-TX-	33-51	B21t	7.5	1.8	1.2	0.5	11.0	1.9	12.9	85	0.38	6.7	6.2
363-4	51-76	B22t	7.9	2.4	0.9	0.4	11.6	1.9	13.5	86	0.24	7.1	6.5
	76-127	B23t	7.6	3.4	1.5	0.3	12.8	1.7	14.5	88	0.20	7.5	6.8
	127-183	B24t	7.9	4.0	1.4	0.4	13.7	1.8	15.5	88	0.17	7.1	6.6
	183-203	B3ca	---	3.7	0.8	0.3	---	---	---	---	0.06	7.7	7.5
Decordova:	0-15	Ap	1.5	0.3	0	0.3	2.1	1.3	3.4	62	0.18	6.2	5.5
Sample no.	15-36	B21t	3.0	0.9	*	0.3	4.2	1.3	5.5	76	0.19	6.6	5.9
S76-TX-	36-58	B22t	3.2	1.0	*	0.2	4.4	1.3	5.7	77	0.16	6.7	5.9
363-3	58-84	B23t	3.5	1.1	*	0.1	4.7	1.3	6.0	78	0.10	6.6	5.7
	84-124	B24t	3.2	1.1	*	0.1	4.4	1.1	5.5	80	0.07	6.4	5.6
	124-203	B3t	2.7	1.0	*	0.1	3.8	.9	4.7	81	0.06	6.4	5.7
Minwells:	0-15	Ap	6.6	1.5	0.0	0.4	8.5	1.2	9.7	88	0.53	7.5	7.0
Sample no.	15-44	B21t	10.5	5.6	0.1	0.5	16.7	5.6	22.3	75	0.53	6.2	5.5
S74-TX-	44-79	B22t	8.4	5.3	0.2	0.4	14.3	4.2	18.5	77	0.31	6.2	5.5
363-1	79-118	B23t	8.5	5.6	0.2	0.4	14.7	2.2	16.9	87	0.20	6.8	6.1
	118-144	B31ca	---	5.9	0.3	0.4	---	---	---	---	0.08	8.0	7.4
	144-179	IIB32ca	---	5.6	0.3	0.3	---	---	---	---	0.01	8.1	7.6
	179-203	IIC1ca	---	2.8	0.2	0.2	---	---	---	---	0	8.3	7.7
	203-223	IIC2ca	---	1.0	0.1	0.1	---	---	---	---	0.01	8.5	7.7

*Trace.

TABLE 19.--ENGINEERING INDEX TEST DATA--Continued

Soil name, report number, horizon, and depth in inches	Classification		Grain size distribution[1]										Liquid limit[2]	Plasticity index[2]	Specific gravity	Shrinkage		
			Larger than 3 inches	Percentage passing sieve--						Percentage smaller than--								
	AASHTO	Unified		7/4 inch	5/8 inch	3/8 inch	No. 4	No. 10	No. 40	No. 200	.05 mm	.005 mm	.002 mm				Limit	Linear	Ratio
			Pct											Pct		G/c3	Pct	Pct	Pct
Demona ls:[8] (S74TX-363-007)																			
A2--------6 to 26	A-2-4(00)	SP-SM	0	100	100	100	100	100	94	9	6	2	--	20	3	2.63	16.0	0.5	1.7
B21t-----26 to 36	A-6 (04)	SC	0	100	100	100	100	100	97	41	38	29	26	33	21	2.65	14.0	9.5	1.8
B22t-----36 to 48	A-7-6(07)	SC	0	100	100	100	99	97	95	44	39	31	30	42	29	2.67	14.0	13.3	1.9
Frio cl:[9] (S73TX-182-002)																			
A12-------8 to 20	A-6 (19)	CL	0	100	100	100	100	100	100	92	84	46	37	37	21	2.68	13.0	12.2	1.9
B21------40 to 60	A-6 (11)	CL	0	100	100	100	100	99	98	74	65	35	30	30	18	2.70	12.0	9.9	2.0
Gaddy lfs:[10] (S74TX-363-010)																			
C1--------6 to 38	A-2-4(00)	SP-SM	0	100	100	100	100	100	100	11	6	--	--	25	3	2.63	21.0	0.3	1.6
C2-------38 to 44	A-4 (00)	ML	0	100	100	100	100	100	100	59	34	2	1	26	4	2.67	22.0	1.8	1.6
Leeray clay:[11] (S73TX-182-005)																			
A12-------8 to 32	A-7-6(28)	CL	0	100	100	100	99	97	94	85	80	48	42	49	32	2.68	11.0	17.4	2.0
Cca------50 to 60	A-6 (15)	CL	0	100	100	100	99	97	93	87	81	46	28	33	19	2.71	12.0	10.8	2.0
Lindy cl:[12] (S73TX-182-006)																			
A1--------0 to 8	A-4 (06)	CL	0	100	100	100	100	100	99	84	64	20	16	30	8	2.58	20.0	5.2	1.6
B21t------8 to 24	A-6 (16)	CL	0	100	100	100	100	100	99	88	75	36	33	35	19	2.69	15.0	10.0	1.8

See footnotes at end of table.

TABLE 19.--ENGINEERING INDEX TEST DATA

[Dashes indicate data were not available]

Soil name, report number, horizon, and depth in inches	Classification		Grain size distribution[1]										Liquid limit[2]	Plasticity index[2]	Specific gravity	Shrinkage		
			Larger than 3 inches	Percentage passing sieve--						Percentage smaller than--								
	AASHTO	Unified		7/4 inch	5/8 inch	3/8 inch	No. 4	No. 10	No. 40	No. 200	.05 mm	.005 mm	.002 mm				Limit	Linear	Ratio
			Pct											Pct		G/c3	Pct	Pct	Pct
Apalo vfsl:[3] (S74TX-363-003)																			
Ap--------0 to 5	A-4 (01)	ML	0	100	100	100	100	100	100	82	58	9	7	25	3	2.65	21.0	2.0	1.6
B22------25 to 40	A-4 (02)	CL-ML	0	100	100	100	100	100	100	80	53	12	10	25	4	2.68	20.0	2.7	1.7
B3ca-----52 to 70	A-4 (02)	ML	0	100	100	100	100	100	100	84	59	11	9	26	4	2.65	20.0	3.0	1.7
Bastrop fsl:[4] (S74TX-363-004)																			
Ap--------0 to 10	A-4 (00)	SM-SC	0	100	100	100	100	100	96	45	30	6	5	20	4	2.66	17.0	1.3	1.7
B21t-----13 to 20	A-6 (08)	CL	0	100	100	100	100	99	97	66	51	27	25	30	16	2.65	14.0	8.3	1.8
B23t-----30 to 50	A-6 (08)	CL	0	100	100	100	100	100	98	64	52	26	25	30	17	2.64	15.0	8.3	1.8
B3ca-----72 to 80	A-6 (06)	CL	0	100	100	100	99	99	96	66	49	20	19	29	13	2.67	18.0	6.0	1.8
Bosque cl:[5] (S74TX-363-009)																			
A12-------8 to 28	A-7-6(23)	CL	0	100	100	100	100	100	100	96	86	42	32	41	23	2.68	17.0	11.7	1.8
C1-------34 to 50	A-6 (15)	CL	0	100	100	100	100	100	100	84	74	34	23	34	20	2.69	15.0	9.8	1.9
Chaney lfs:[6] (S73TX-182-003)																			
A2--------6 to 16	A-2-4(00)	SM	0	100	100	100	99	98	93	19	17	5	4	16	2	2.64	15.0	0.5	1.7
B21t-----16 to 30	A-6 (06)	SC	0	100	100	100	99	98	93	43	42	32	32	39	25	2.65	13.0	12.7	1.9
B22t-----30 to 45	A-7-6(11)	CL	0	100	100	100	99	98	93	53	49	37	37	46	29	2.69	12.0	15.4	1.9
Decordova lfs:[7] (S74TX-363-002)																			
Ap--------0 to 6	A-2-4(00)	SM-SC	0	100	100	100	100	100	98	30	18	3	2	21	4	2.65	19.0	1.3	1.6
B23t-----23 to 33	A-4 (00)	SM-SC	0	100	100	100	100	100	98	38	28	10	7	20	4	2.64	17.0	1.5	1.8
B24t-----49 to 80	A-2-4(00)	SM	0	100	100	100	100	100	98	28	19	6	6	20	3	2.66	18.0	1.2	1.7

See footnotes at end of table.

TABLE 19.--ENGINEERING INDEX TEST DATA--Continued

Soil name, report number, horizon, and depth in inches	Classification		Grain size distribution[1]										Liquid limit[2]	Plasticity index[2]	Specific gravity	Shrinkage		
			Larger than 3 inches	Percentage passing sieve--						Percentage smaller than--						Limit	Linear	Ratio
	AASHTO	Unified		7/4 inch	5/8 inch	3/8 inch	No. 4	No. 10	No. 40	No. 200	.05 mm	.005 mm	.002 mm					
			Pct											Pct		G/c3	Pct	Pct	Pct
Minwells fsl:[13] (S74TX-363-001)																		
Ap--------0 to 6	A-4 (02)	CL	0	100	100	99	98	96	90	59	42	14	10	24	8	2.65	16.0	4.5	1.8
B21t------6 to 17	A-7-6(24)	CL	0	100	100	100	100	99	96	80	71	42	39	47	31	2.70	14.0	15.0	1.9
B31ca----46 to 57	A-6 (13)	CL	0	100	100	99	99	98	95	74	57	25	23	35	21	2.69	17.0	9.5	1.8
IIb32ca--57 to 71	A-2-7(01)	SC	0	100	92	88	74	49	33	19	16	10	9	42	28	2.71	15.0	13.0	1.9
Palopinto xst-cl:[14] (S75TX-363-002)																			
A1--------0 to 4	A-7-6(29)	CH	30	100	100	100	99	99	99	92	85	39	29	54	28	2.56	21.0	13.4	1.6
Santo fsl:[15] (S74TX-363-006)																			
C2-------12 to 36	A-4 (00)	SM	0	100	100	100	100	100	100	39	27	8	6	22	3	2.65	20.0	1.6	1.7
C3-------36 to 44	A-2-4(00)	SM	0	100	100	100	100	100	100	25	16	5	4	21	3	2.66	19.0	1.4	1.7
C4-------44 to 70	A-4 (00)	SM	0	100	100	100	100	100	100	37	24	8	5	21	3	2.65	18.0	2.0	1.7
Set xst-c:[16] (S75TX-363-004)																			
A1--------0 to 12	A-7-6(33)	CH	20	100	100	100	99	98	96	93	90	60	46	56	31	2.62	14.0	17.6	1.9
B21ca----12 to 26	A-7-6(24)	CH	0	100	100	98	95	91	84	81	78	59	46	52	29	2.71	13.0	17.0	1.9
C--------44 to 60	A-6 (12)	CL	0	100	100	99	98	96	93	85	78	32	20	33	16	2.69	17.0	8.3	1.8
Shatruce vb-sl:[17] (S75TX-363-003)																			
A2--------2 to 14	A-2-4(00)	SM-SC	10	100	100	81	72	59	50	28	24	10	7	17	4	2.65	13.0	2.7	1.9
B21t-----14 to 20	A-7-6(18)	CL	0	100	100	100	100	100	99	74	71	57	49	43	26	2.72	13.0	14.4	1.9
C--------34 to 60	A-6 (17)	CL	0	100	100	100	100	99	99	76	72	49	37	39	25	2.79	14.0	12.7	1.9

See footnotes at end of table.

TABLE 19.--ENGINEERING INDEX TEST DATA--Continued

Soil name, report number, horizon, and depth in inches	Classification		Grain size distribution[1]										Liquid limit[2]	Plasticity index[2]	Specific gravity	Shrinkage		
			Larger than 3 inches	Percentage passing sieve--							Percentage smaller than--							
	AASHTO	Unified		7/4 inch	5/8 inch	3/8 inch	No. 4	No. 10	No. 40	No. 200	.05 mm	.005 mm	.002 mm				Limit	Linear	Ratio
			Pct											Pct		G/c^3	Pct	Pct	Pct
Shavash st-lfs:[18] (S75TX-363-001)																			
A2--------4 to 10	A-2-4(00)	SM	0	100	100	99	98	96	86	14	11	5	3	17	2	2.65	15.0	1.2	1.7
B21t-----10 to 16	A-6 (03)	SC	0	100	100	100	98	97	94	41	40	34	32	32	18	2.68	15.0	9.0	1.8
Thurber cl:[19] (S73TX-182-001)																			
Ap--------0 to 8	A-6 (06)	CL	0	100	100	100	100	100	98	72	62	27	21	26	12	2.63	14.0	6.7	1.9
B21t------8 to 26	A-6 (16)	CL	0	100	100	100	100	100	99	80	72	40	34	37	22	2.68	13.0	12.3	1.9
Cca------36 to 72	A-6 (17)	CL	0	100	100	100	100	99	97	74	68	40	35	40	26	2.67	11.0	14.4	2.0
Yahola vfsl:[20] (S73TX-182-004)																			
A12-------8 to 22	A-4 (00)	ML	0	100	100	100	100	100	100	58	40	10	8	23	3	2.64	20.0	2.3	1.6
C1--------22 to 45	A-2-4(00)	SM	0	100	100	100	100	100	100	31	20	4	4	21	3	2.65	19.0	1.6	1.6

[1]For soil materials larger than 3/8 inch, square mesh wire sieves were used that are slightly larger than equivalent round sieves, but these differences do not seriously affect the data.

[2]Liquid limit and plastic index values were determined by the AASHTO-89 and AASHTO-90 methods except that soil was added to water.

[3]Apalo very fine sandy loam:
from northeast end of U.S. Highway 281 bridge over Brazos River, 0.25 mile northeast and 150 feet west of road in pasture.

[4]Bastrop fine sandy loam:
from northeast end of U.S. Highway 281 bridge over Brazos River, 0.8 mile north and 60 feet west of highway in pasture.

[5]Bosque clay loam:
from junction of Texas Highway 16 and Walnut Street in Strawn, east on Walnut Street and county road for 2.7 miles, and 200 feet northeast.

[6]Chaney loamy fine sand:
from junction of U.S. Highway 281 and Texas Highway 4, east on Texas Highway 4 for 3 miles, north on county road for 1.9 miles, and 50 feet west of road.

[7]Decordova loamy fine sand:
3 miles west of Mineral Wells on U.S. Highway 180, 2 miles south, 1 mile southwest, and 550 feet northwest.

[8]Demona loamy sand:
from junction of U.S. Highway 281 and Farm Road 4, west on Farm Road 4 for 1.4 miles, and 50 feet south in pasture.

[9]Frio clay loam:
from Gordon, north 3.3 miles on Farm Road 919, east on county road for 0.8 mile, and south for 1,500 feet.

[10]Gaddy loamy fine sand:
from west end of U.S. Highway 180 bridge over Brazos River, west 3.5 miles, south and east on county road for 4.1 miles, and 1.5 miles to river.

[11]Leeray clay:
from junction of Texas Highway 254 and Farm Road 206 in Graford, 4,400 feet south on county road to junction, and 75 feet west in field.

[12]Lindy clay loam:
from junction of Farm Road 4 and Texas Highway 254 west of Graford, south on Farm Road 4 for 1.4 miles, south on county road, 1.4 miles, west 1.25 miles, 600 feet.

[13]Minwells fine sandy loam:
from junction of U.S. Highways 281 and 180 in Mineral Wells, west on U.S. Highway 180 for 5.4 miles, 600 feet south of highway.

[14]Palopinto extremely stony clay loam:
from junction of U.S. Highways 180 and 281 in Mineral Wells, north on U.S. Highway 281 for 8 miles, west and north on Texas Highway 254 for 3.6 miles, and 1,600 feet east.

[15]Santo fine sandy loam:
from Santo, east on Farm Road 129 for 3.9 miles, south on private road for 0.7 mile, and 100 feet north of Palo Pinto Creek.

[16]Set extremely stony clay:
from junction of Texas Highways 16 and 108 in Strawn, north on Texas Highway 108 for 0.9 mile, west on Farm Road 207 for 5.1 miles, north on county road for 1.2 miles, and 15 feet east.

[17]Shatruce very bouldery sandy loam:
from junction of U.S. Highway 281 and Farm Road 2256 south of edge of Mineral Wells, south on U.S. Highway 281 for 5.6 miles, and 45 feet west.

[18]Shavash stony loamy fine sand:
from junction of Farm Roads 4 and 129 in Santo, north on Farm Road 4 for 4.2 miles, west on paved road, 1.1 miles and 60 feet north in rangeland.

[19]Thurber clay loam:
from Gordon, north on Farm Road 919 for 1.3 miles, east on Farm Road 2692 for 0.9 mile, and 50 feet south of road.

[20]Yahola very fine sandy loam:
from Brazos, west on Farm Road 129 for 1.8 miles, north and west on county road for 1.5 miles, and north on pasture road for 1.7 mile.

TABLE 20.--CLASSIFICATION OF THE SOILS

[An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series]

Soil name	Family or higher taxonomic class
Apalo	Coarse-silty, mixed, thermic Udic Ustochrepts
Bastrop	Fine-loamy, mixed, thermic Udic Paleustalfs
Blanket	Fine, mixed, thermic Pachic Argiustolls
Bonti	Fine, mixed, thermic Ultic Paleustalfs
Bosque	Fine-loamy, mixed, thermic Cumulic Haplustolls
Chaney	Fine, mixed, thermic Aquic Paleustalfs
Decordova	Coarse-loamy, siliceous, thermic Udic Paleustalfs
Demona	Clayey, mixed, thermic Aquic Arenic Paleustalfs
Eufaula	Sandy, siliceous, thermic Psammentic Paleustalfs
Exray	Clayey, mixed, thermic Lithic Rhodustalfs
Frio	Fine, mixed, thermic Cumulic Haplustolls
Gaddy	Sandy, mixed, thermic Typic Ustifluvents
Hassee	Fine, montmorillonitic, thermic Mollic Albaqualfs
Hensley	Clayey, mixed, thermic Lithic Rhodustalfs
Leeray	Fine, montmorillonitic, thermic Typic Chromusterts
Lindy	Fine, mixed, thermic Udic Haplustalfs
May	Fine-loamy, mixed, thermic Udic Haplustalfs
Minwells	Fine, mixed, thermic Udic Paleustalfs
Owens	Clayey, mixed, thermic, shallow Typic Ustochrepts
Palopinto	Loamy-skeletal, mixed, thermic Lithic Haplustolls
Patilo	Loamy, siliceous, thermic Grossarenic Paleustalfs
Santo	Coarse-loamy, mixed (calcareous), thermic Typic Ustifluvents
Set	Fine-silty, carbonatic, thermic Typic Calciustolls
Shatruce	Fine, mixed, thermic Ultic Paleustalfs
Shavash	Loamy, siliceous, thermic Lithic Haplustalfs
Thurber	Fine, montmorillonitic, thermic Typic Haplustalfs
Truce	Fine, mixed, thermic Udic Paleustalfs
Vashti	Fine-loamy, siliceous, thermic Aquic Haplustalfs
Velow	Fine-loamy, mixed, thermic Typic Haplustolls
*Wichita	Fine, mixed, thermic Typic Paleustalfs
Windthorst	Fine, mixed, thermic Udic Paleustalfs
Yahola	Coarse-loamy, mixed (calcareous), thermic Typic Ustifluvents

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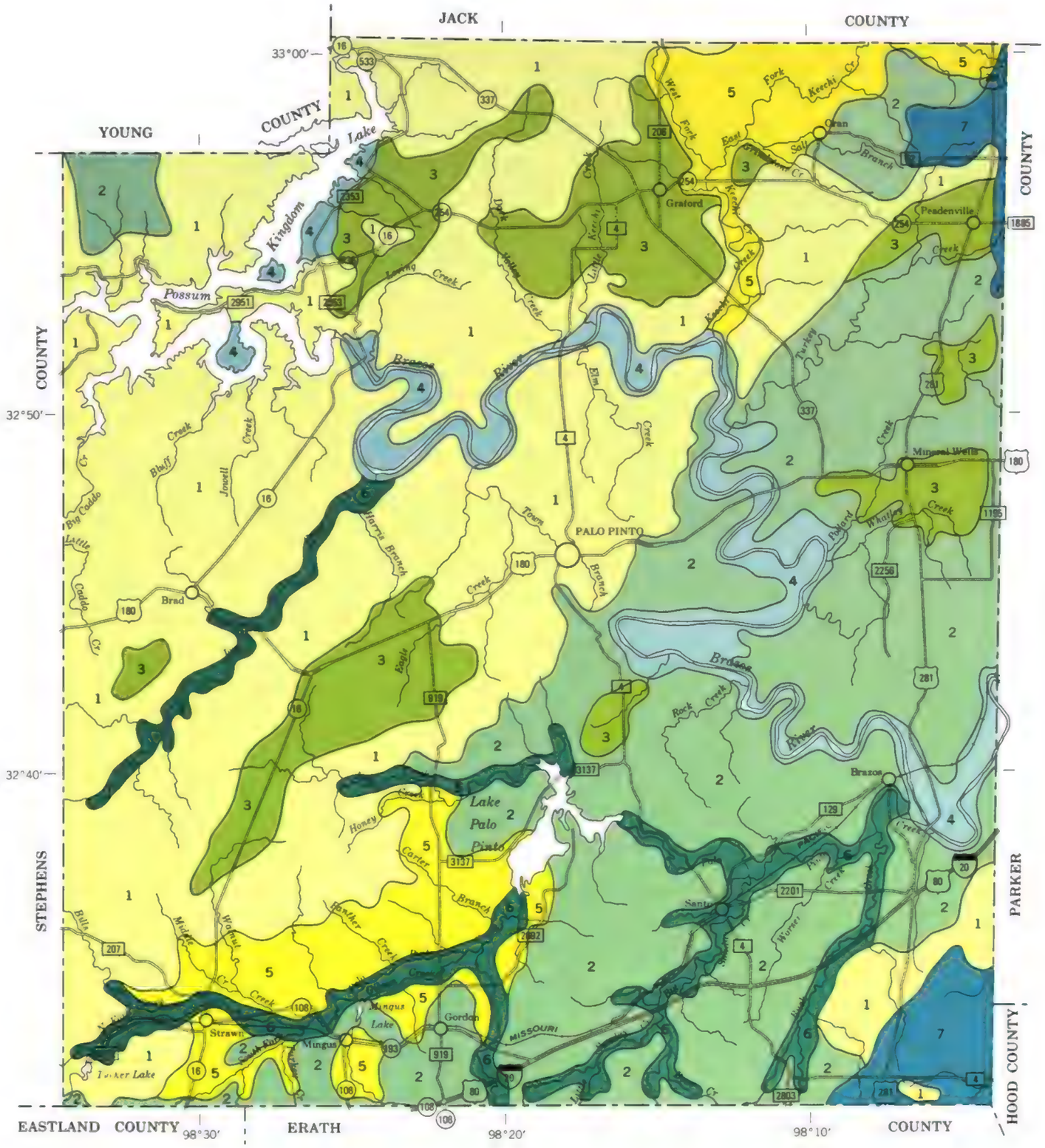


LEGEND

- 1 — PALOPINTO-SET-HENSLEY: Shallow and deep, nearly level to steep, loamy and clayey, stony soils; on uplands
- 2 — BONTI-TRUCE-SHATRUCE: Moderately deep and deep, gently sloping to steep, loamy, stony and bouldery soils; on uplands
- 3 — LEERAY: Deep, nearly level to gently sloping, clayey soils; on uplands
- 4 — BASTROP-APALO: Deep, gently sloping to sloping, loamy soils; on stream terraces
- 5 — MINWELLS-THURBER: Deep, nearly level to gently sloping, loamy soils; on stream terraces and in upland valleys
- 6 — BOSQUE-SANTO: Deep, nearly level to gently sloping, loamy soils; on flood plains
- 7 — CHANEY-WINDTHORST-VASHTI: Deep and moderately deep, gently sloping, sandy and loamy soils; on uplands

Compiled 1980

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TEXAS AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP

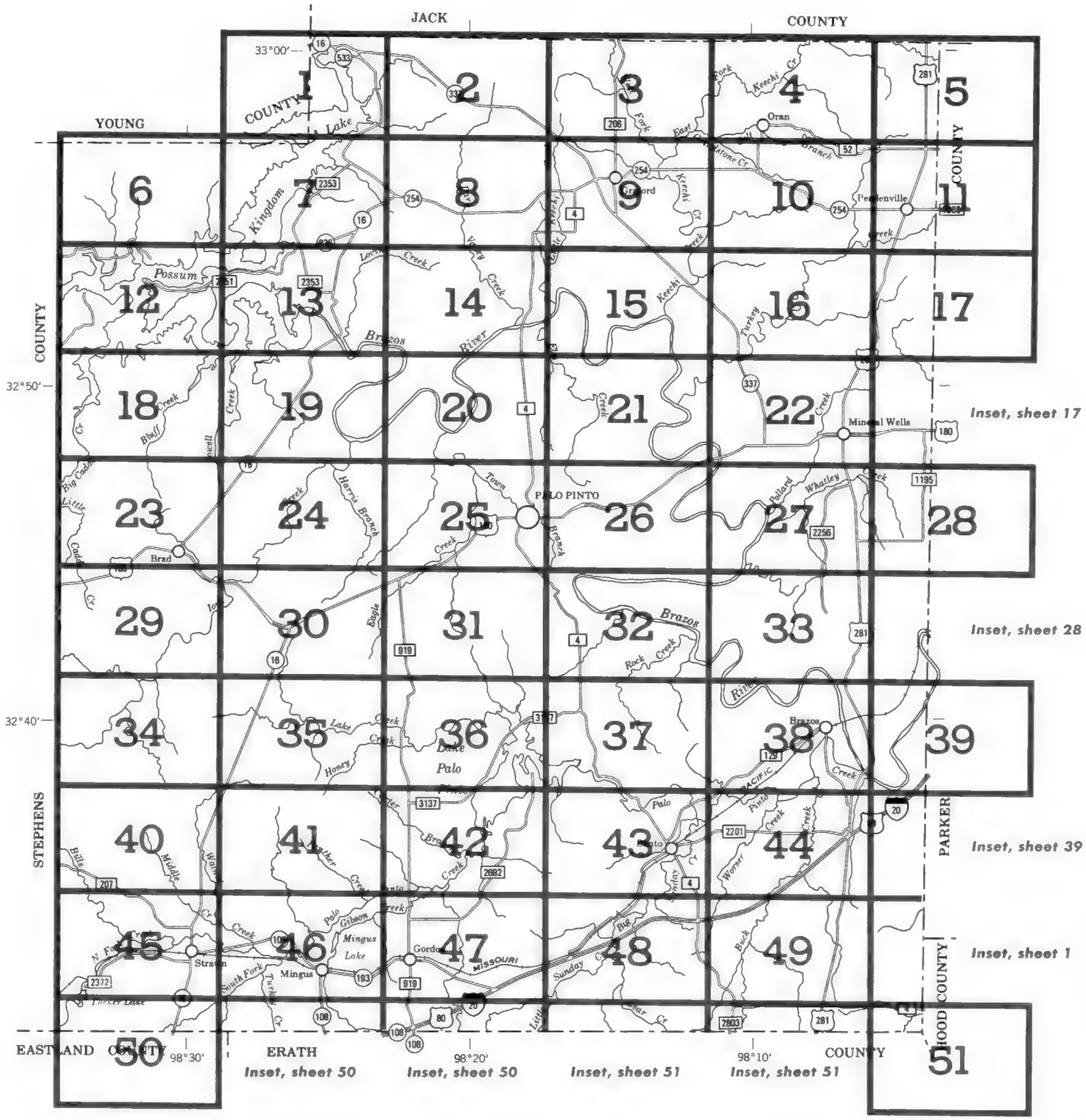
PALO PINTO COUNTY, TEXAS

N

Scale 1:253,440

1 0 1 2 3 4 Miles

1 0 4 8 Km



Original text from each individual map sheet read:
This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division

INDEX TO MAP SHEETS

PALO PINTO COUNTY, TEXAS

Scale 1:253,440

1 0 1 2 3 4 Miles

1 0 4 8 Km

SOIL LEGEND

The legend is numeric. Soil names followed by the superscript 1/ are broadly defined units. The composition of these units is more variable than that of other units in the survey area, but is controlled well enough to be interpreted for the expected use of the soils. Soils without a slope designation in the name are those soils that are found only on nearly level landscapes of flooded bottom lands or those that are miscellaneous areas.

SYMBOL	NAME
1	Apalo very fine sandy loam, 1 to 3 percent slopes
2	Apalo very fine sandy loam, 3 to 5 percent slopes
3	Apalo very fine sandy loam, 5 to 8 percent slopes
4	Bastrop loamy fine sand, 1 to 5 percent slopes
5	Bastrop fine sandy loam, 1 to 3 percent slopes
6	Bastrop fine sandy loam, 3 to 5 percent slopes
7	Bastrop fine sandy loam, 1 to 5 percent slopes, eroded
8	Blanket clay loam, 0 to 1 percent slopes
9	Bonti fine sandy loam, 1 to 3 percent slopes
10	Bonti fine sandy loam, 3 to 5 percent slopes
11	Bonti-Exray complex, very stony, 1 to 8 percent slopes
12	Bosque clay loam, occasionally flooded
13	Chaney loamy fine sand, 1 to 5 percent slopes
14	Decordova loamy fine sand, 0 to 5 percent slopes
15	Demona loamy sand, 0 to 5 percent slopes
16	Eufaula loamy fine sand, 5 to 8 percent slopes
17	Frio clay loam, occasionally flooded
18	Frio clay loam, frequently flooded
19	Hasse loam, 0 to 1 percent slopes
20	Hensley very stony clay loam, 0 to 5 percent slopes
21	Leeray clay, 0 to 1 percent slopes
22	Leeray clay, 1 to 3 percent slopes
23	Leeray clay, 3 to 5 percent slopes
24	Lindy clay loam, 1 to 3 percent slopes
25	May very fine sandy loam, 0 to 1 percent slopes
26	Dumps, mine
27	Minwells fine sandy loam, 1 to 3 percent slopes
28	Minwells fine sandy loam, 3 to 5 percent slopes
29	Minwells fine sandy loam, 1 to 5 percent slopes, eroded
30	Owens clay, 1 to 5 percent slopes
31	Owens very stony clay, 1 to 8 percent slopes
32	Owens very stony clay, 8 to 40 percent slopes
33	Palopinto extremely stony clay loam, 1 to 8 percent slopes
34	Patilo fine sand, 1 to 3 percent slopes
35	Santo fine sandy loam, frequently flooded
36	Set clay, 1 to 3 percent slopes
37	Set clay, 3 to 5 percent slopes
38	Set-Palopinto complex, extremely stony, 8 to 40 percent slopes
39	Shatruce very bouldery sandy loam, 8 to 40 percent slopes
40	Shavash stony loamy fine sand, 1 to 3 percent slopes
41	Thurber clay loam, 0 to 1 percent slopes
42	Thurber clay loam, 1 to 3 percent slopes
43	Truce fine sandy loam, 1 to 3 percent slopes
44	Truce fine sandy loam, 3 to 5 percent slopes
45	Truce fine sandy loam, 1 to 5 percent slopes, eroded
46	Truce-Bonti complex, extremely stony, 8 to 40 percent slopes
47	Veshti loamy fine sand, 1 to 5 percent slopes
48	Velow clay loam, 1 to 3 percent slopes
49	Velow clay loam, 3 to 5 percent slopes
50	Wichita clay loam, 1 to 3 percent slopes
51	Windthorst fine sandy loam, 1 to 3 percent slopes
52	Yahola and Gaddy soils, occasionally flooded 1/

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline & neatline
- AD HOC BOUNDARY (label) — Hedley Armstrong
- Small airport, airfield, park, oilfield, cemetery, or flood pool — FLOOD POOL LINE
- STATE COORDINATE TICK
- LAND DIVISION CORNERS (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEM & DESIGNATIONS

- Interstate — 21
- Federal — 175
- State — 28
- County, farm or ranch — 1288

- RAILROAD
- POWER TRANSMISSION LINE (normally not shown)
- PIPE LINE (normally not shown)
- FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or small — water — tp

PITS

- Gravel pit
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Indian mound (label) — Indian Mound
- Located object (label) — Tower
- Tank (label) — Gas
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
  - Double-line (label) — CANAL
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial — water — tp
- Intermittent — int — i

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

- SOIL DELINEATIONS AND SYMBOLS — CnB — WaC2
- ESCARPMENTS
  - Bedrock (points down slope)
  - Other than bedrock (points down slope)
- SHORT STEEP SLOPE
- GULLY
- DEPRESSION OR SINK
- SOIL SAMPLE SITE (normally not shown)
- MISCELLANEOUS
  - Blowout
  - Clay spot
  - Gravelly spot
  - Gumbo, slick or scabby spot (sodic)
  - Dumps and other similar non soil areas
  - Prominent hill or peak
  - Rock outcrop (includes sandstone and shale)
  - Saline spot
  - Sandy spot
  - Severely eroded spot
  - Slide or slip (tips point upslope)
  - Stony spot, very stony spot — 0

PALO PINTO COUNTY, TEXAS — SHEET NUMBER 1

(Joins inset, sheet 39)

1 820 000 FEET

1 715 000 FEET

330 000 FEET

490 000 FEET

JACK COUNTY

PARKER COUNTY

YOUNG COUNTY

HOOD COUNTY

Rock Creek

Rock Creek

Livecock Hill Creek

Gordon Mountain

POSSUM KINGDOM LAKE

Carter Island

Ramsey Creek

Frost Branch

(Joins sheet 49)

(Joins sheet 51)

(Joins sheet 7)

(Joins sheet 2)

315 000 FEET

475 000 FEET

1 825 000 FEET

1 725 000 FEET

N

2 Miles

10000 Feet

Scale 1:24000

PALO PINTO COUNTY, TEXAS — SHEET NUMBER 2

(2)

N

2 Miles

10000 Feet

1

5000

Scale 1:24000

0

1000

2000

3000

4000

5000

1 755 000 FEET

JACK COUNTY

(Joins sheet 1)

Branch

Ramsey Creek

Valley Creek

Dark

Little Keechi Creek

(Joins sheet 3)

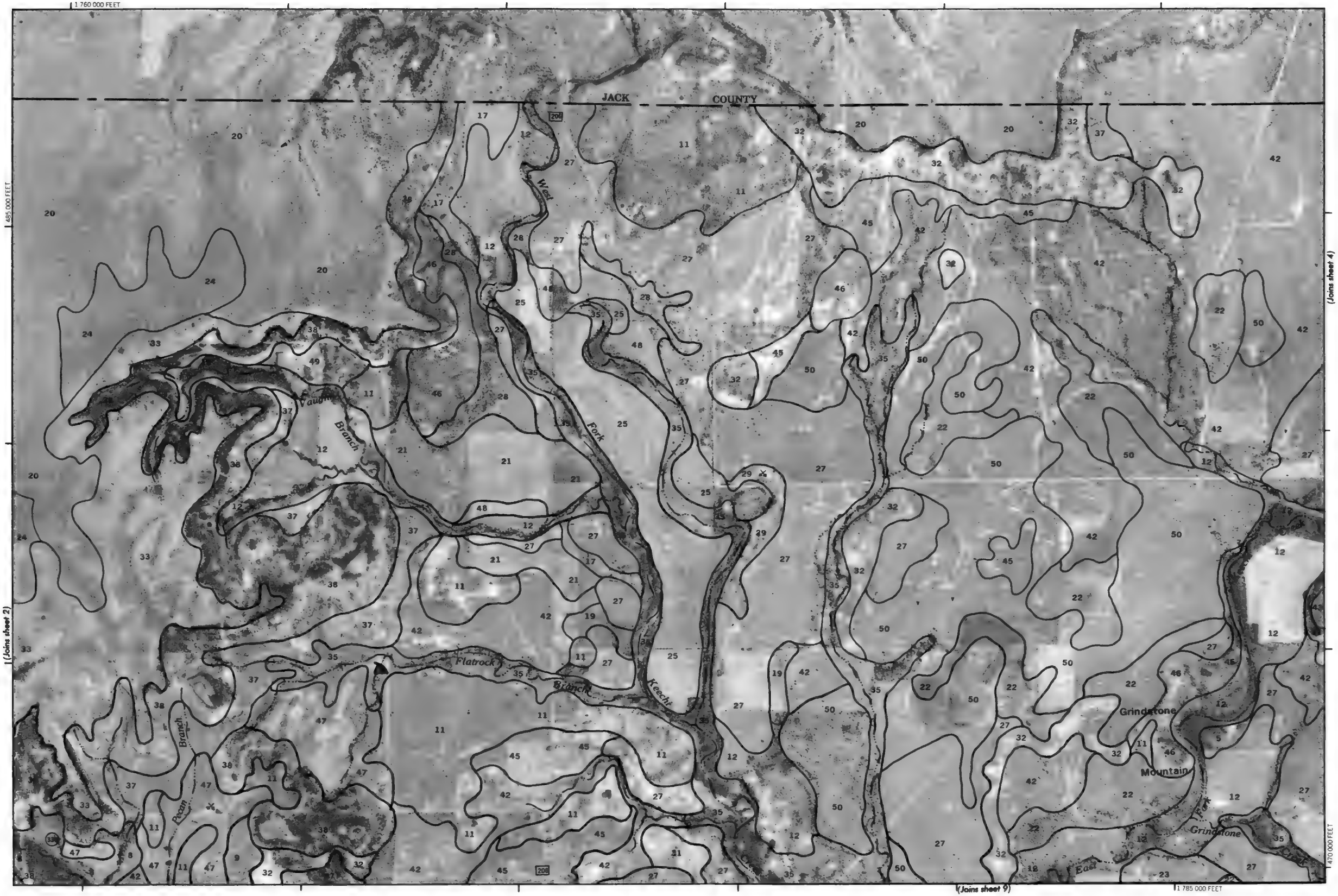
(Joins sheet 8)

1 730 000 FEET

1 475 000 FEET

1 485 000 FEET

PALO PINTO COUNTY, TEXAS — SHEET NUMBER 3



PALO PINTO COUNTY, TEXAS — SHEET NUMBER 4

(4)

N

JACK COUNTY

Creek

Keechi

Bear

Creek

Salt Branch

Oran

water

water

(Joins sheet 3)

(Joins sheet 5)

(Joins sheet 10)

1 790 000 FEET

470 000 FEET

485 000 FEET

2 Miles

10000 Feet

Scale 1:24000

PALO PINTO COUNTY, TEXAS — SHEET NUMBER 5

1 820 000 FEET

485 000 FEET

JACK COUNTY

PARKER COUNTY

Moore Creek

water

(Joins sheet 4)

(Joins sheet 11)

1 845 000 FEET

470 000 FEET

5

N

2 Miles

10000 Feet

1

5000

Scale 1:24000

0 0

¼ 1000

½ 2000

¾ 3000

1 4000

5000

PALO PINTO COUNTY, TEXAS — SHEET NUMBER 6

6

N

1 695 000 FEET

YOUNG COUNTY

STEPHENS COUNTY

Pickard Creek

Elm Creek

Ainsworth Creek

Caudill Mountain

POSSUM KINGDOM LAKE

1148

water

(Joins sheet 12)

(Joins sheet 7)

1 670 000 FEET

2 Miles

10000 Feet

Scale 1:24000

PALO PINTO COUNTY, TEXAS — SHEET NUMBER 7

7

N

1 700 000 FEET

1 470 000 FEET

(Joins sheet 1)

(Joins sheet 6)

(Joins sheet 8)

(Joins sheet 13)

1 725 000 FEET

455 000 FEET

YOUNG COUNTY

POSSUM KINGDOM LAKE

Devils Hollow

Harris Peak

Bloodweed Island

Sand Island

Bald Mountain

Costello Island

McGinnis Point

water

Mt Avoy Mountain

Storms Mountain

Lukingdom

Deep Elm Creek

Loving Creek

2353

736

2 Miles

10000 Feet

1

5000

Scale 1:24000

0 0 1000 2000 3000 4000 5000

PALO PINTO COUNTY, TEXAS — SHEET NUMBER 8

8

N

(Joins sheet 2)

1 755 000 FEET

470 000 FEET

Deep Elm Creek

Dark Valley Creek

(Joins sheet 7)

(Joins sheet 9)

1 730 000 FEET

(Joins sheet 14)

2 Miles 10000 Feet

1 5000

Scale 1:24000

0 0

¼ 1000

½ 2000

¾ 3000

1 4000

1¼ 5000

PALO PINTO COUNTY, TEXAS — SHEET NUMBER 9

1 760 000 FEET

(Joins sheet 3)

9

N

2 Miles

10000 Feet

5000

0

1

Scale 1:24000

455 000 FEET

470 000 FEET

(Joins sheet 8)

(Joins sheet 10)

(Joins sheet 15)

1 785 000 FEET

Graford

Pecan Branch

West Fork Keechi Creek

East Fork Keechi Creek

Keechi Creek

Little Keechi Creek

PALO PINTO COUNTY, TEXAS — SHEET NUMBER 10

10

N

2 Miles

10000 Feet

1 5000

Scale 1:24000

0 0 1000 2000 3000 4000 5000

(Joins sheet 4)

1 815 000 FEET

465 000 FEET

456 000 FEET

(Joins sheet 9)

(Joins sheet 11)

1 790 000 FEET

(Joins sheet 16)

Grindstone Creek

Salt Branch

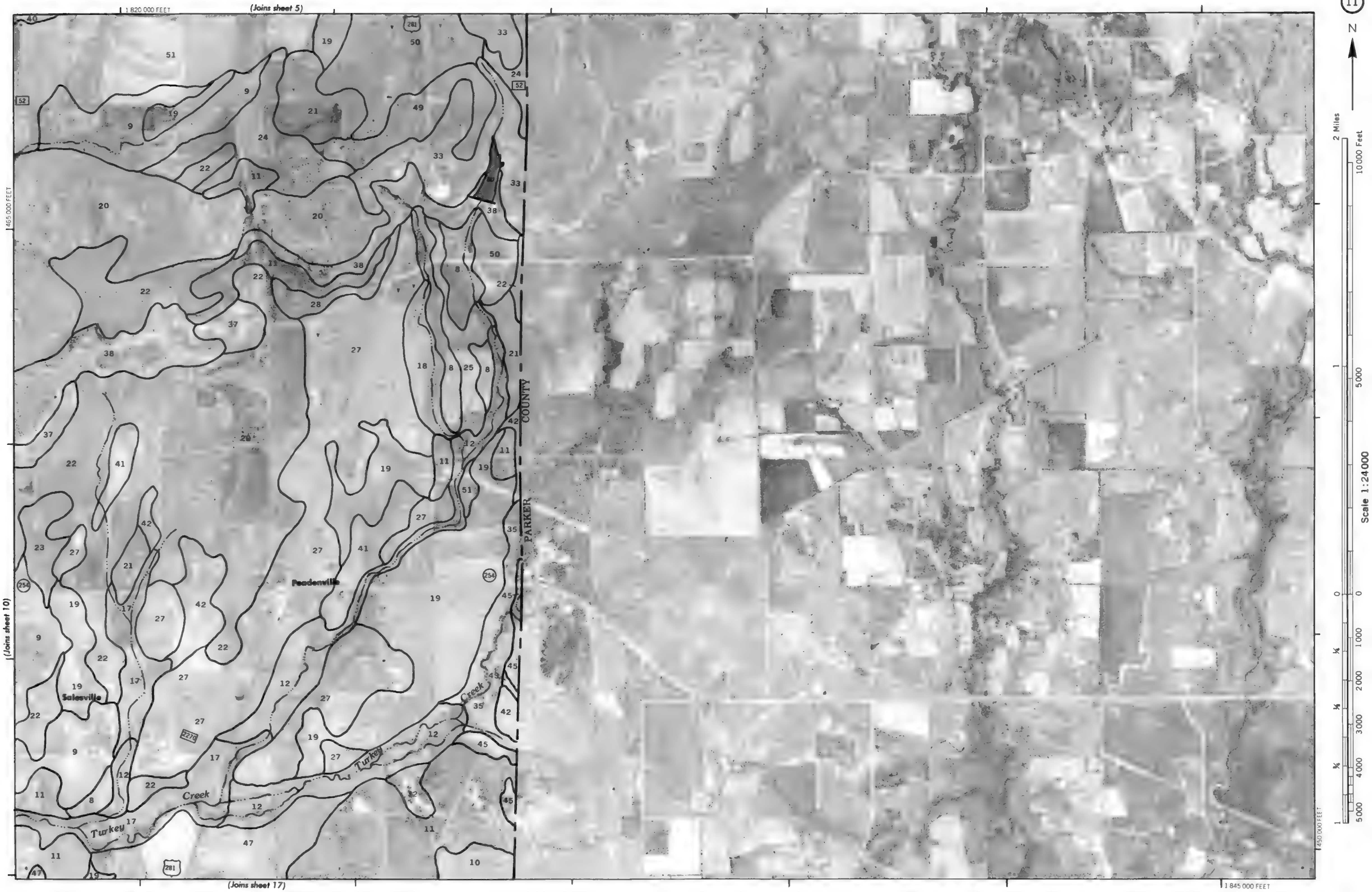
Rock Crusher Lake

Live Oak Canyon

Bear Hollow

Turkey Creek

PALO PINTO COUNTY, TEXAS — SHEET NUMBER 11



12

N

2 Miles

10000 Feet

Scale 1:24000

1 5000 0 0 1000 2000 3000 4000 5000

(Joins sheet 6)

1 695 000 FEET

350 000 FEET

POSSUM KINGDOM LAKE

Sandy Beach

Poor Bend

Johnson Peak

Hog Bend

Bass Island

Cuddo Bay

Malonley Creek

Hubbard Creek

Strip Landing

POSSUM KINGDOM STATE PARK

STEPHENS COUNTY

1 435 000 FEET

1 670 000 FEET

(Joins sheet 18)

(Joins sheet 13)

(Joins sheet 7)

(Joins sheet 12)

(Joins sheet 19)

(Joins sheet 14)

1 700 000 FEET

1 725 000 FEET

450 000 FEET

415 500 FEET

13

N

2 Miles

10000 Feet

5000

Scale 1:24000

5000 4000 3000 2000 1000 0 0

POSSUM KINGDOM LAKE

Costello Island

McAdams Peak

McAdams

Creek

Loving

Gaines Bend

Johnson Bend

Frank Harris Bend

Halls Gate

MORRIS SHEPPARD DAM

BRAZOS RIVER

State Fish Hatchery

Loving Creek

Flint Bend

BRAZOS RIVER

2353

2951

2952

P36

PALO PINTO COUNTY, TEXAS — SHEET NUMBER 14

14

N

2 Miles

10000 Feet

Scale 1:24000

(Joins sheet 8)

(Joins sheet 13)

(Joins sheet 15)

(Joins sheet 20)

1 758 000 FEET

1 730 000 FEET

435 000 FEET

Elm Creek

Little Keechi Creek

Valley

Creek

BRAZOS RIVER

Garland Bend

BRAZOS RIVER

PALO PINTO COUNTY, TEXAS — SHEET NUMBER 15

15

N

1 760 000 FEET

(Joins sheet 9)

435 000 FEET

Keechi Creek

Little Keechi Creek

Soda Spring Creek

Scott Canyon

B C Harris Bend

RIVER

Hollow

Birdwell

BRAZOS

Metcalf Bend

Hart Bend

RIVER

Elm Creek

(Joins sheet 14)

(Joins sheet 16)

(Joins sheet 21)

1 785 000 FEET

2 Miles

10000 Feet

Scale 1:24000

16

N

(Joins sheet 10)

1 815 000 FEET

4 430 000 FEET

(Joins sheet 15)

Spring Creek

Soda

Turkey Creek

Devils Hollow

(Joins sheet 17)

4 435 000 FEET

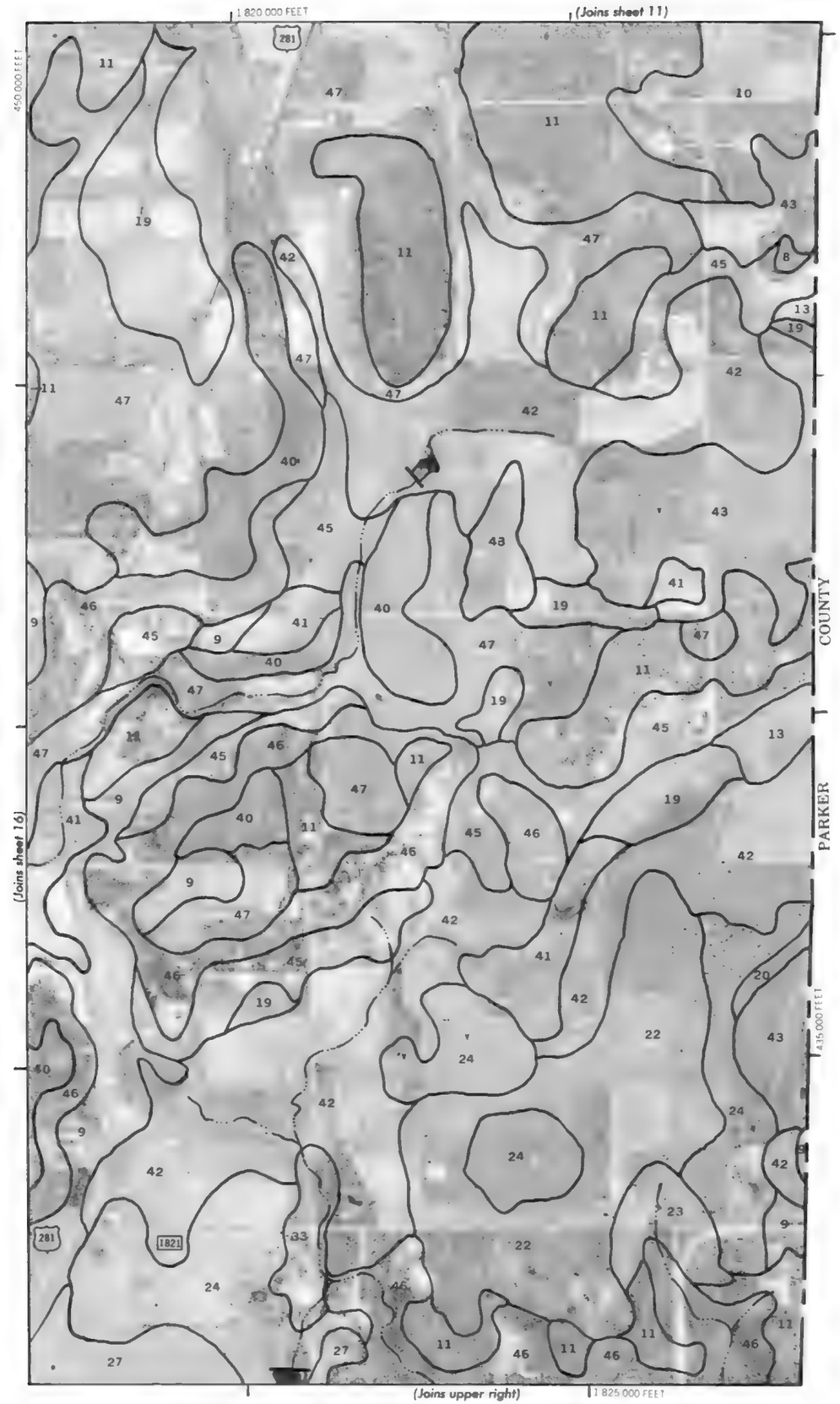
1 790 000 FEET

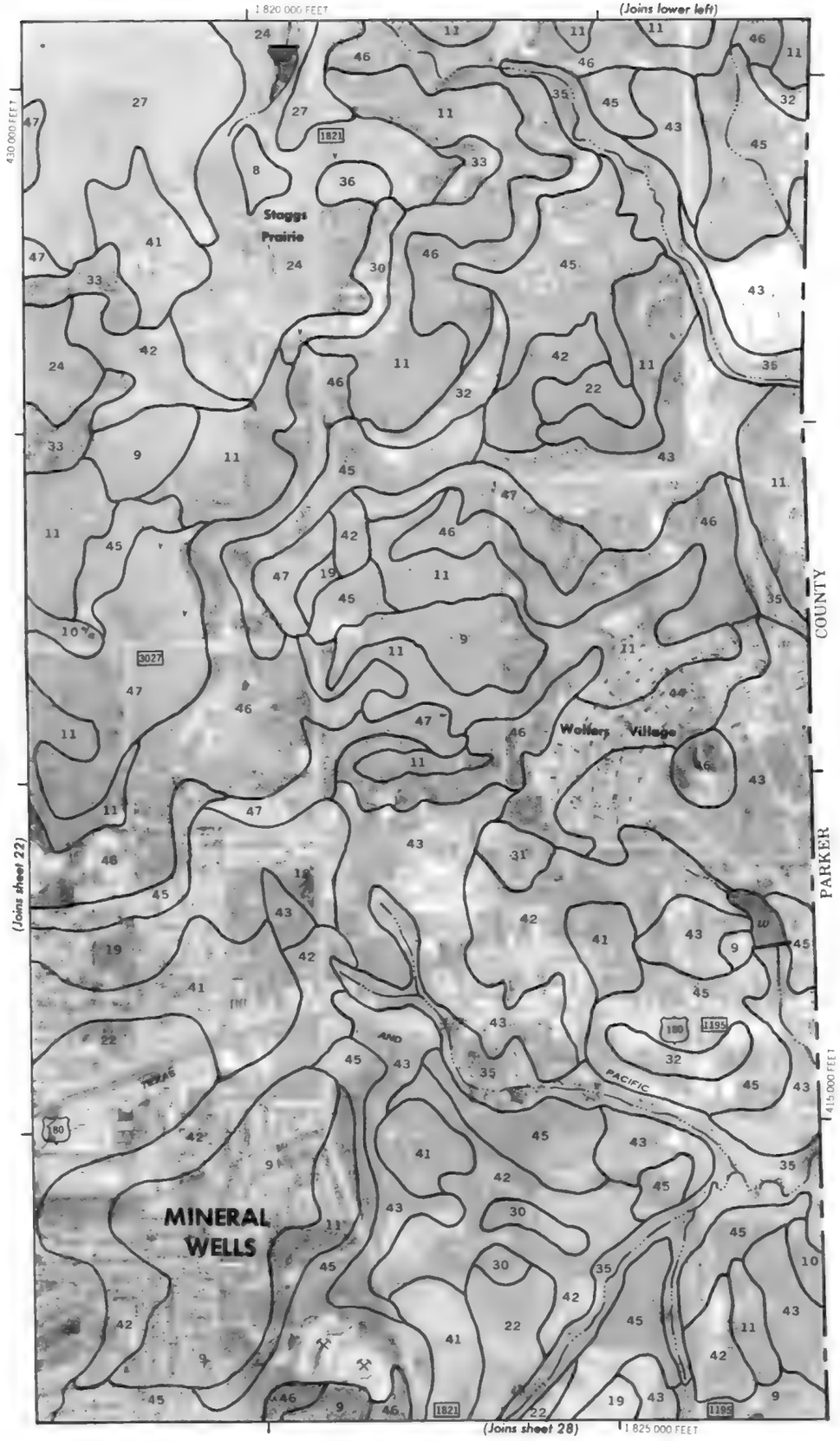
(Joins sheet 22)

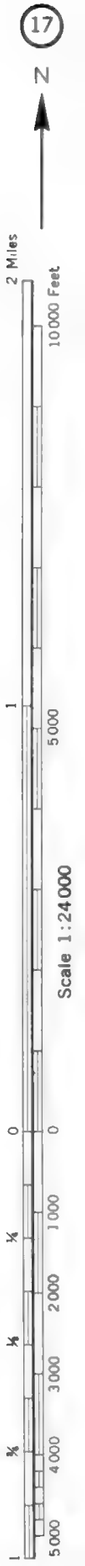
2 Miles 10000 Feet

Scale 1:24000

PALO PINTO COUNTY, TEXAS — SHEET NUMBER 17







PALO PINTO COUNTY, TEXAS — SHEET NUMBER 18

(18)

N

(Joins sheet 12)

1 695 000 FEET

430 000 FEET

POSSUM KINGDOM LAKE

POSSUM KINGDOM LAKE

water

Long Hollow

Bee Creek

Haynick Mountain

Dillinhunt

Hollow

Blue Creek

COUNTY

STEPHENS

Bear Hollow

Big Caddo Creek

Yellow Gap

Bluff Creek

Hamilton Hollow

Jowell Creek

415 000 FEET

1 670 000 FEET

(Joins sheet 23)

(Joins sheet 19)

2 Miles

10000 Feet

1

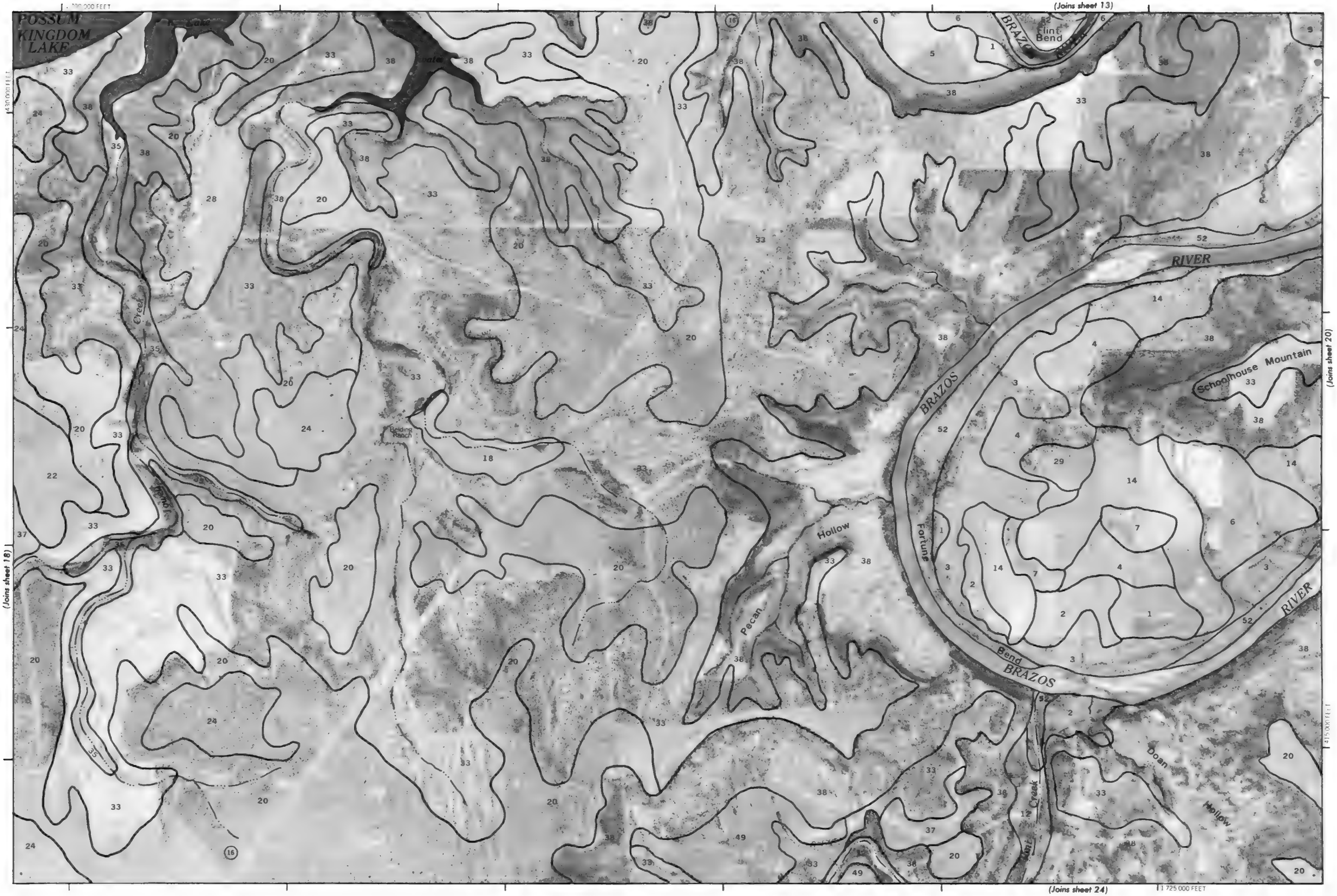
5000

Scale 1:24000

0 0

1000 2000 3000 4000 5000

PALO PINTO COUNTY, TEXAS — SHEET NUMBER 19



PALO PINTO COUNTY, TEXAS — SHEET NUMBER 20

20

N

(Joins sheet 14)

1 765 000 FEET

430 000 FEET

Garland Bend

RIVER

BRAZOS

Mountain

Schoolhouse

Crawford Bend

Dalton Bend

Mill Branch

Lyle Mountain

Chick Bend

Crawford

Hollow

Rubin Creek

(Joins sheet 21)

415 000 FEET

1 730 000 FEET

(Joins sheet 25)

2 Miles

10000 Feet

1

5000

Scale 1:24000

0 0

¼ 1000

½ 2000

¾ 3000

1 4000

1¼ 5000

PALO PINTO COUNTY, TEXAS — SHEET NUMBER 21

21

N

1 760 000 FEET

(Joins sheet 15)

430 000 FEET

Post Oak Bend

BRAZOS RIVER

Mill Branch

Elm Creek

Thunderbird Hollow

Jones Hollow

Moffitt Bend

Turkey Creek

Ballenger Bend

BRAZOS RIVER

Bath Bend

BRAZOS RIVER

(Joins sheet 20)

(Joins sheet 22)

(Joins sheet 26)

1 785 000 FEET

415 000 FEET

2 Miles

10000 Feet

Scale 1:24000

22

N

2 Miles

10000 Feet

1

5000

Scale 1:24000

0

1000

2000

3000

4000

5000

(Joins sheet 16)

(Joins sheet 21)

(Joins sheet 27)

(Joins inset, sheet 17)

1 815 000 FEET

430 000 FEET

415 000 FEET

1 790 000 FEET

Turkey Creek

Baker Hollow

BRAZOS RIVER

Bath Bend

Indian Creek

Pollard Hill

Pollard Creek

East Mountain

MINERAL WELLS

281

180

337

3027

PALO PINTO COUNTY, TEXAS — SHEET NUMBER 23

1 670 000 FEET

(Joins sheet 18)

10 000 FEET

COUNTY

STEPHENS

Big Caddo Creek

Sam Bass Hollow

Bluff Creek

Hamilton Hollow

Caddo Creek

Little Lont Creek

Brad Branch

Brad

Little

(Joins sheet 24)

(Joins sheet 29)

1 695 000 FEET

395 000 FEET

23

N

2 Miles

10000 Feet

1

5000

Scale 1:24000

0 1000 2000 3000 4000 5000

PALO PINTO COUNTY, TEXAS — SHEET NUMBER 24

24

N

(Joins sheet 19)

1 725 000 FEET

410 000 FEET

(Joins sheet 23)

Ioni Creek

Harris

Doan Hollow

Crawford Mountain

Antelope Mountain

18 Branch

(Joins sheet 25)

395 000 FEET

1 700 000 FEET

(Joins sheet 30)

2 Miles

10 000 Feet

Scale 1:24 000

1 5000 0 0 1000 2000 3000 4000 5000

PALO PINTO COUNTY, TEXAS — SHEET NUMBER 25

25

N

1 730 000 FEET

(Joins sheet 20)

410 000 FEET

(Joins sheet 24)

(Joins sheet 31)

1 755 000 FEET

395 000 FEET

Eagle Creek

Mountain

Crawford

Branch

Eagle Creek

Town

Branch

Wolf

Palo Pinto (county seat)

Eagle Creek

Mill Branch

Branch

(Joins sheet 26)

2 Miles

10000 Feet

1

5000

Scale 1:24000

0 0

¼ 1000

½ 2000

¾ 3000

1 4000

1¼ 5000

PALO PINTO COUNTY, TEXAS — SHEET NUMBER 26

26

N

2 Miles

10000 Feet

1

5000

Scale 1:24000

0

0

1/4

1000

1/2

2000

3/4

3000

1

4000

1 1/4

5000

(Joins sheet 21)

(Joins sheet 25)

1 785 000 FEET

1 410 000 FEET

1 395 000 FEET

1 760 000 FEET

(Joins sheet 32)

(Joins sheet 27)

Elm Creek

Mountain

Wynn

BRAZOS RIVER

Pollard Bend

Barber Mountain

water

PALO PINTO COUNTY, TEXAS — SHEET NUMBER 27

27

N

1 790 000 FEET

(Joins sheet 22)

MINERAL WELLS

BRAZOS RIVER

Hittson Bend

Pollard Creek

Whalley Creek

Baker Creek

(Joins sheet 26)

(Joins sheet 28)

(Joins sheet 33)

1 810 000 FEET

1 815 000 FEET

395 000 FEET

2 Miles

10000 Feet

Scale 1:24000

28

N

2 Miles

10000 Feet

1

5000

Scale 1:24000

(Joins inset, sheet 17)

1 825 000 FEET

410 000 FEET

MINERAL WELLS

MINERAL WELLS AIRFIELD

COUNTY

PARKER

(Joins sheet 27)

395 000 FEET

1 820 000 FEET

(Joins upper right)

(Joins lower left)

1 825 000 FEET

(Joins sheet 33)

375 000 FEET

BRAZOS RIVER

Littlefield Bend

Valley

Gilbert

(Joins sheet 39)

PALO PINTO COUNTY, TEXAS — SHEET NUMBER 29

29

N

1 670 000 FEET

(Joins sheet 23)

390 000 FEET

STEPHENS COUNTY

Little Caddo Creek

Lone Star Lake

Branch

Mosley

Little Joni Creek

Joni Creek

PALO PINTO MOUNTAINS

(Joins sheet 30)

(Joins sheet 34)

1 695 000 FEET

375 000 FEET

2 Miles

10000 Feet

Scale 1:24000

5000

PALO PINTO COUNTY, TEXAS — SHEET NUMBER 30

30

N

(Joins sheet 24)

1 725 000 FEET

390 000 FEET

(Joins sheet 29)

(Joins sheet 31)

375 000 FEET

1 700 000 FEET

(Joins sheet 35)

Ioni Creek

Harris Branch

Eagle Creek

PALO PINTO MOUNTAINS

Sugarloaf Mountain

Metcalf Gap

Scale 1:24000

2 Miles 10000 Feet

1 5000

PALO PINTO COUNTY, TEXAS — SHEET NUMBER 31

31

N

1 738 000 FEET

1 390 000 FEET

(Joins sheet 25)

(Joins sheet 30)

(Joins sheet 32)

(Joins sheet 36)

1 755 000 FEET

1 375 000 FEET

Eagle Creek

Mill Branch

Bear Canyon

Kettle

Wilson Hollow

Scale 1:24000

2 Miles 10000 Feet

PALO PINTO COUNTY, TEXAS — SHEET NUMBER 32

32

N

(Joins sheet 26)

1 785 000 FEET

390 000 FEET

BRAZOS RIVER

Village Bend

BRAZOS RIVER

Branch

Ward

Rock Creek

John Hittson Bend

(Joins sheet 33)

(Joins sheet 31)

375 000 FEET

1 760 000 FEET

(Joins sheet 37)

2 Miles

10000 Feet

Scale 1:24000

PALO PINTO COUNTY, TEXAS — SHEET NUMBER 33

33

N

(Joins sheet 27)

(Joins inset, sheet 28)

(Joins sheet 32)

(Joins sheet 38)

1:790,000 FEET

1:395,000 FEET

1:375,000 FEET

1:15,000 FEET

2 Miles

1

10000 Feet

5000

Scale 1:24000

BRAZOS RIVER

Baker Creek

Rocky Knoll

Chestnut Bend

Edmondson Bend

Brewton Canyon

Polk Stalk Bend

2256

281

PALO PINTO COUNTY, TEXAS — SHEET NUMBER 34

(34)

N

2 Miles

10000 Feet

1

5000

Scale 1:24000

0 0 1000 2000 3000 4000 5000

(Joins sheet 29)

1 695 000 FEET

(Joins sheet 35)

355 000 FEET

1 670 000 FEET

(Joins sheet 40)

STEPHENS COUNTY

PALO PINTO MOUNTAINS

Ioni Creek

Ioni Creek

PALO PINTO COUNTY, TEXAS — SHEET NUMBER 35

1 700 000 FEET

(Joins sheet 30)

35

N

2 Miles

10000 Feet

(Joins sheet 36)

Scale 1:24000

5000 0 1000 2000 3000 4000 5000

1 355 000 FEET

(Joins sheet 34)

Dodson Prairie

(Joins sheet 41)

1 725 000 FEET

36

N

2 Miles

10000 Feet

1 5000

Scale 1:24000

0 0

1/4 1000

1/2 2000

3/4 3000

1 4000

5000

(Joins sheet 31)

1 755 000 FEET

370 000 FEET

(Joins sheet 35)

355 000 FEET

1 730 000 FEET

(Joins sheet 42)

(Joins sheet 37)

Bear Canyon

Kettle Hollow

Wilson Hollow

Lake Creek

Lake Creek

Horsehead Creek

WHIT MOUNTAIN

LAKE PALO PINTO

PALO PINTO COUNTY, TEXAS — SHEET NUMBER 37

1 760 000 FEET

(Joins sheet 32)

(Joins sheet 36)

(Joins sheet 38)

(Joins sheet 43)

1 785 000 FEET

355 000 FEET

37

N

Scale 1:24000

2 Miles

10000 Feet

5000

Lone Camp

Ward Mountain

Hittson Branch

Dry Branch

LAKE PALO PINTO

Palo Pinto Creek

Pinto Creek

3137

PALO PINTO COUNTY, TEXAS — SHEET NUMBER 38

38

N

2 Miles

10000 Feet

Scale 1:24000

(Joins sheet 33)

(Joins sheet 37)

(Joins sheet 39)

(Joins sheet 44)

1 815 000 FEET

370 000 FEET

355 000 FEET

1 790 000 FEET

Sand Valley

Whitley Bend

Cyclone Bend

BRAZOS RIVER

Dobbs Valley

Palo Pinto Creek

Buck Creek

Collier C

Hollow

T AND P

PACIFIC

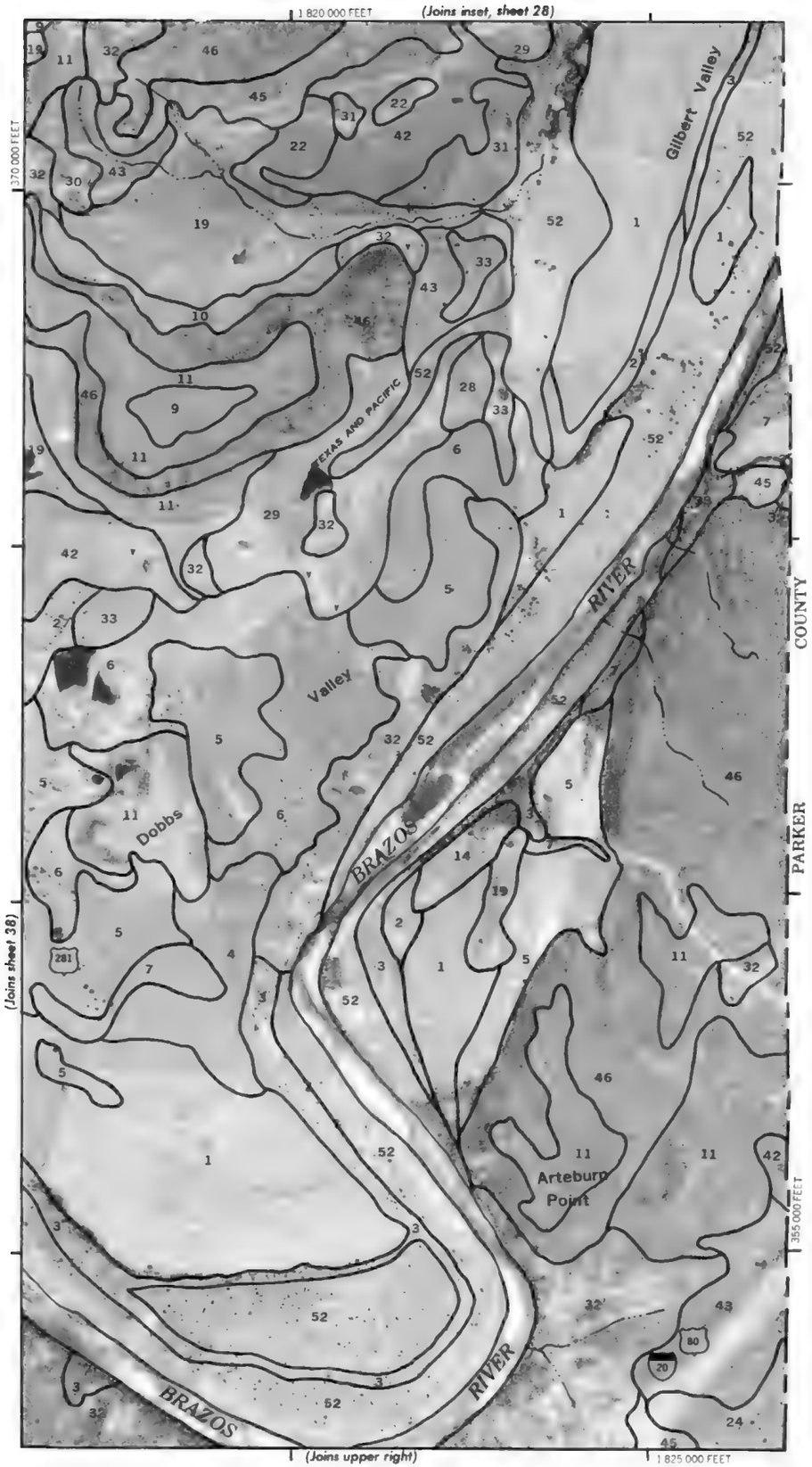
TEXAS

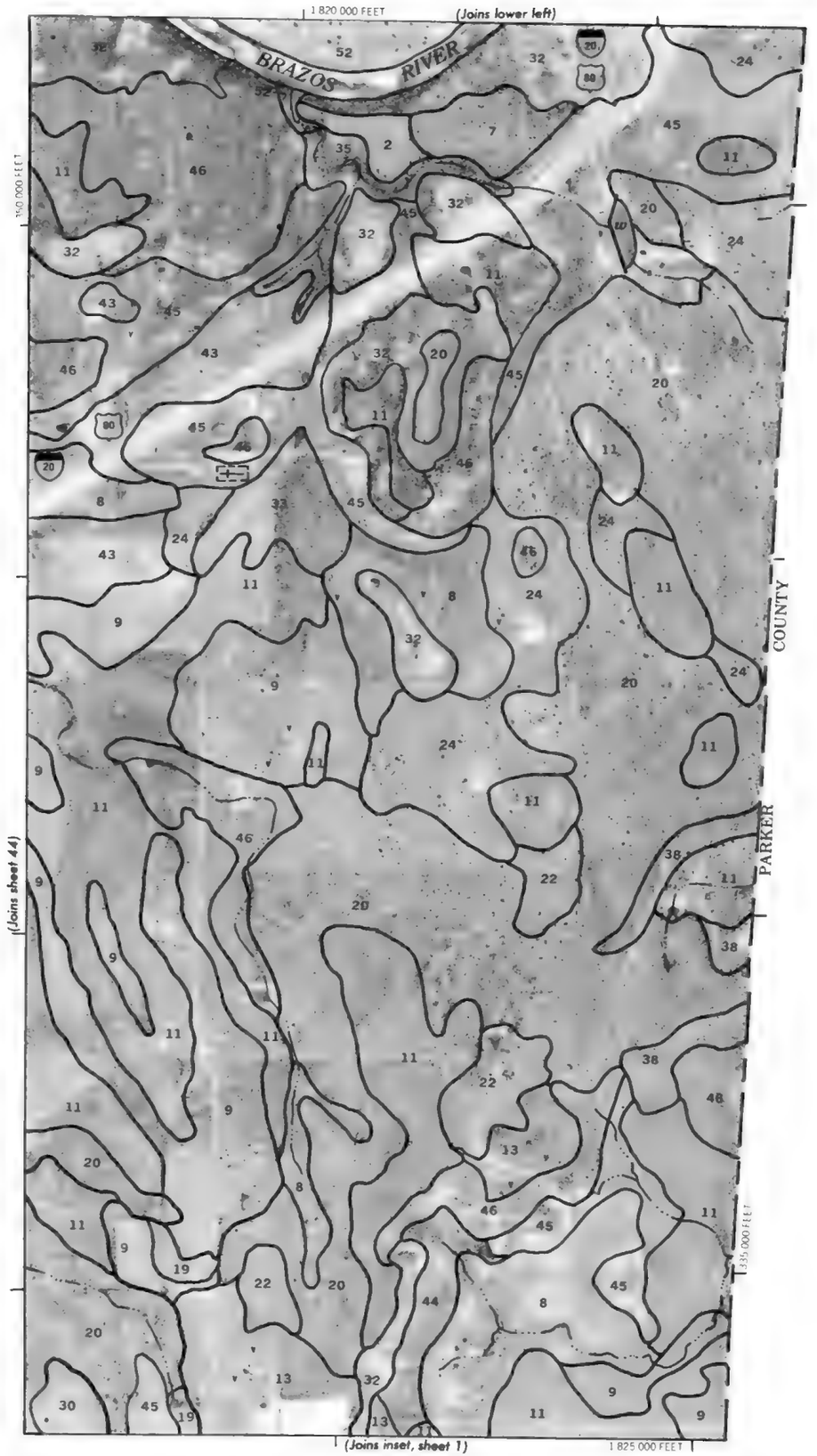
AND

281

129

PALO PINTO COUNTY, TEXAS — SHEET NUMBER 39





PALO PINTO COUNTY, TEXAS — SHEET NUMBER 40

(40)

N

2 Miles

10000 Feet

1

5000

Scale 1:24000

0 1000 2000 3000 4000 5000

(Joins sheet 34)

1 695 000 FEET

350 000 FEET

335 000 FEET

1 670 000 FEET

(Joins sheet 45)

(Joins sheet 41)

PALO PINTO MOUNTAINS

STEPHENS COUNTY

South Bills Creek

Bills Creek

Middle Creek

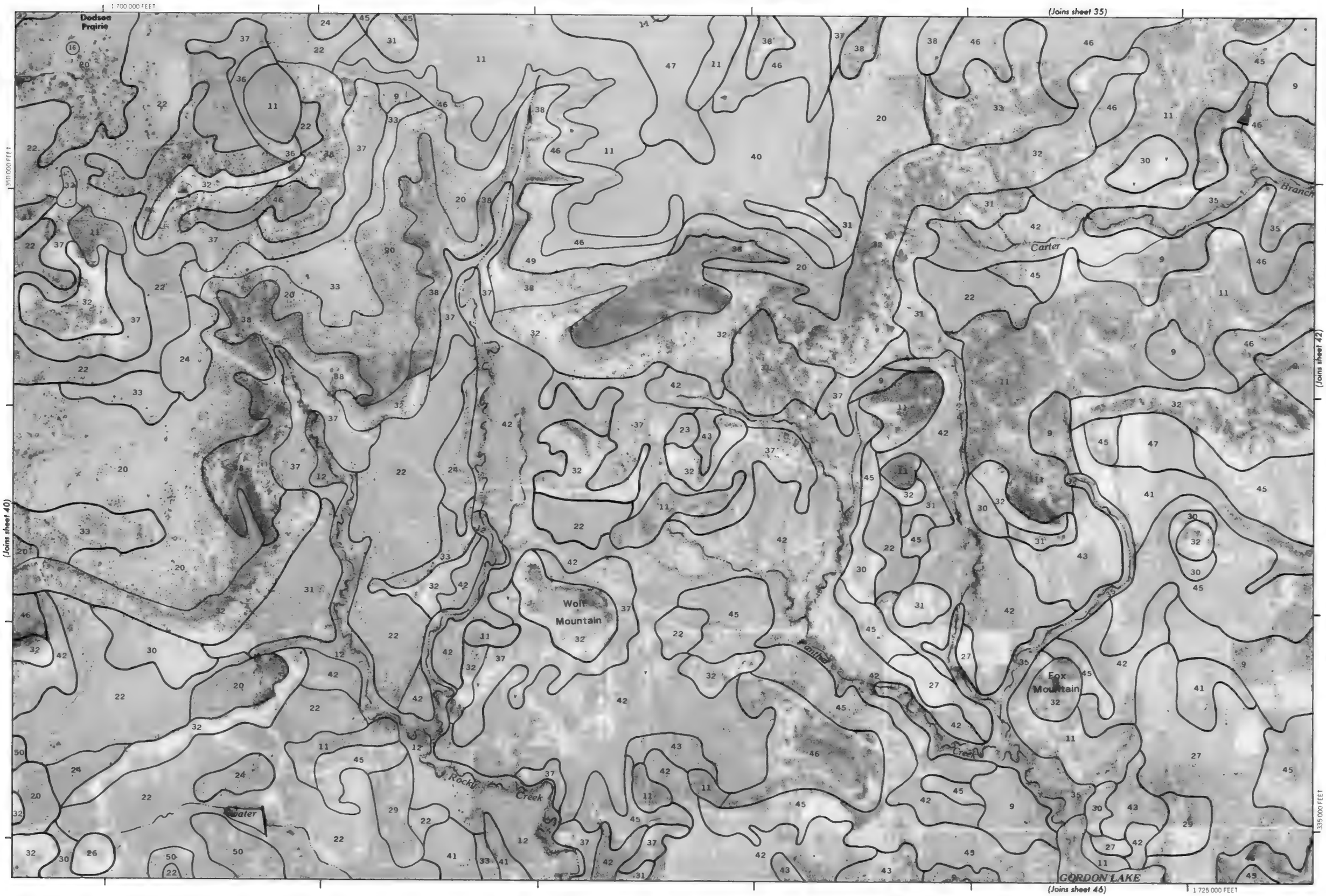
Kamui Creek

water

207

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned

PALO PINTO COUNTY, TEXAS — SHEET NUMBER 41



PALO PINTO COUNTY, TEXAS — SHEET NUMBER 42

42

N

2 Miles 10000 Feet

1 5000

Scale 1:24000

0 0

¼ 1000

½ 2000

¾ 4000

1 5000

(Joins sheet 36)

(Joins sheet 41)

1 755 000 FEET

350 000 FEET

335 000 FEET

1 730 000 FEET

(Joins sheet 47)

(Joins sheet 43)

LAKE PALO PINTO

Johnson Lake

Carter

Branch

Snider

Branch

Panther Creek

Branch

Snider

Palo Pinto

Barton Creek

Creek

James Lake

CLAYTON MOUNTAIN

water

water

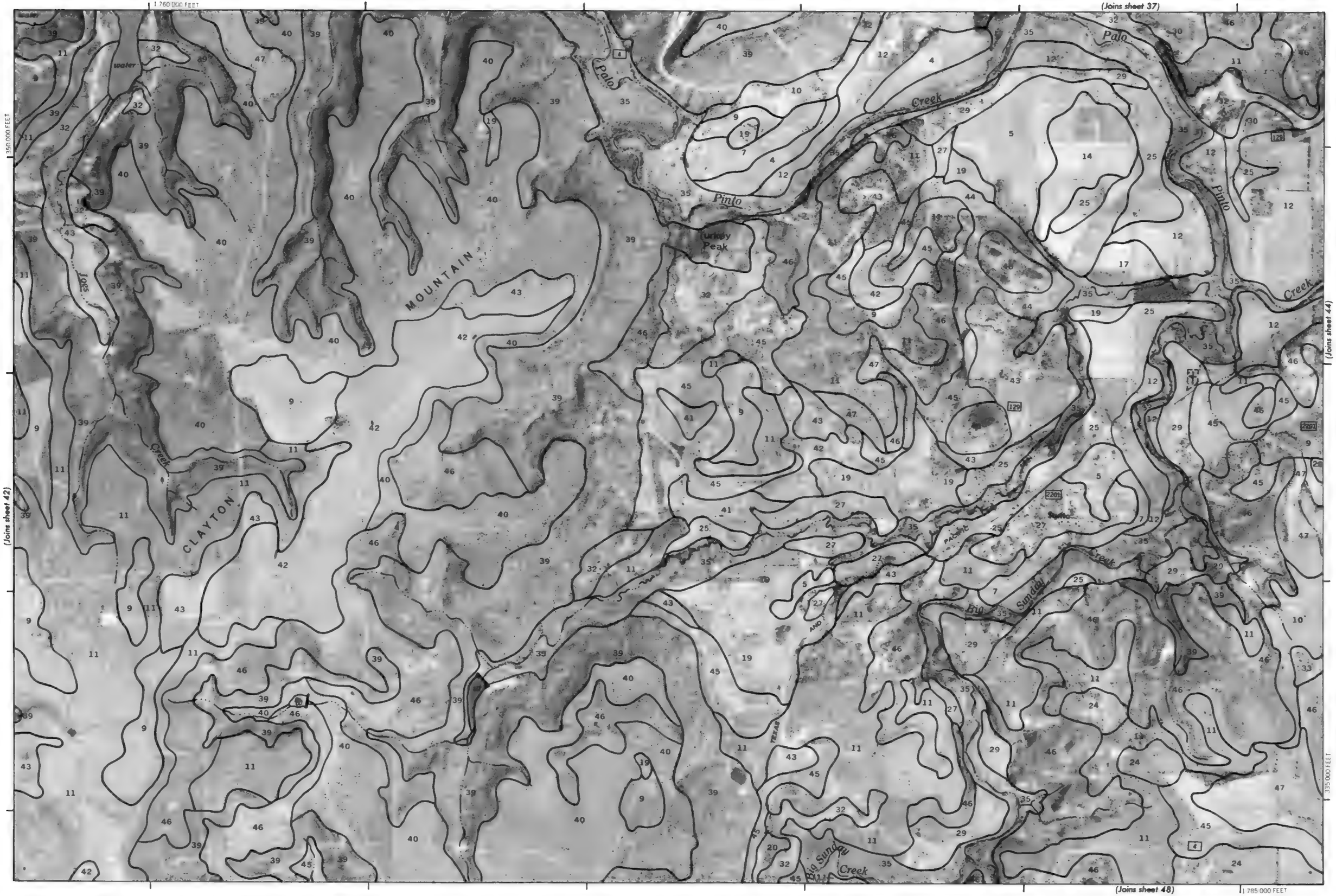
915

3137

2692

919

PALO PINTO COUNTY, TEXAS — SHEET NUMBER 43



PALO PINTO COUNTY, TEXAS — SHEET NUMBER 44

(44)

N

2 Miles

10000 Feet

1

5000

Scale 1:24000

0

1000

2000

3000

4000

5000

1:125,000 FEET

(Joins sheet 38)

(Joins sheet 43)

(Joins sheet 49)

(Joins inset, sheet 39)

1:790,000 FEET

1:815,000 FEET

Palo Pinto Creek

Pinto Creek

Pinto Creek

Pacific and Texas

Devils Hollow

Wurser Creek

Buck Creek

Buck Creek

Buck Creek

New Salem

PALO PINTO COUNTY, TEXAS — SHEET NUMBER 45

45

1 670 000 FEET

(Joins sheet 40)

N

2 Miles

10000 Feet

5000

1

(Joins sheet 46)

Scale 1:24000

0 1000 2000 3000 4000 5000

1 5 000 FEET

STEPHENS COUNTY

1 695 000 FEET

(Joins sheet 50)

Walnut Creek

Middle Creek

water

Bills Creek

Palo Pinto Creek

North Fork Palo Pinto Creek

TEXAS AND PACIFIC

Strawn

Everville Peak

Tucker Lake

North Fork Palo Pinto Creek

Landing Strip

Copeland Ranch Landing Strip

Skunk Ridge

46

N

2 Miles 10000 Feet

1 5000

Scale 1:24000

0 0 1000 2000 3000 4000 5000 FEET

(Joins sheet 41)

1 725 000 FEET

(Joins sheet 45)

(Joins sheet 47)

315 000 FEET

1 700 000 FEET

(Joins inset A, sheet 50)

GORDON LAKE

Panther Creek

Pinto Creek

Palo Pinto Gibson Creek

Walnut Creek

Lyra

Rock Creek

Pinto Creek

Palo Pinto Creek

TEXAS AND PACIFIC

T P Lake

McSpadden

Dickson-Walker Mountain

Tater Hill

Gibson Creek

Skunk Ridge

Palo Pinto South Fork

Turkey Creek

PALO PINTO COUNTY, TEXAS — SHEET NUMBER 47

47

N

1 730 000 FEET

330 000 FEET

315 000 FEET

1 755 000 FEET

(Joins sheet 42)

(Joins sheet 46)

(Joins sheet 48)

(Joins inset B, sheet 50)

Scale 1:24000

2 Miles 1 0 1

10000 Feet 5000 0 5000

Palo Pinto Creek

Gibson Creek

Burton Creek

Coalville

Clayton Springs

MOUNTAIN

CLAYTON

Saline Creek

Swank Mountain

Gordon AND PACIFIC TEXAS

Wilbar Mountain

Mitchell Mountain

Bushy Mountain

Gordon Junction

Bridges Branch

water

48

N

Scale 1:24000

2 Miles 1 0 1

10000 Feet 5000 0 5000

(Joins sheet 43)

(Joins sheet 47)

(Joins sheet 49)

(Joins inset B, sheet 51)

1 785 000 FEET

330 000 FEET

315 000 FEET

1 760 000 FEET

Brierton

Russell Mountain

Panama Creek

Saline Creek

Sunday Creek

Big Sunday Creek

Bear Creek

Bridges Branch

Little Sunday Creek

Big Creek

PACIFIC AND TEXAS

water

PALO PINTO COUNTY, TEXAS — SHEET NUMBER 49

49

1 790 000 FEET

(Joins sheet 44)

330 000 FEET

Bugle Mountain

Worser Creek

Rocky Branch Creek

(Joins sheet 48)

(Joins inset, sheet 1)

315 000 FEET

(Joins inset A, sheet 51)

1 815 000 FEET

N

2 Miles

10000 Feet

Scale 1:24000

PALO PINTO COUNTY, TEXAS — SHEET NUMBER 50

50

N

2 Miles 10000 Feet

1 5000

Scale 1:24000

0 0

¼ 1000

½ 2000

¾ 3000

¼ 4000

5000

(Joins sheet 45)

1 695 000 FEET

315 000 FEET

(Joins inset A, lower left)

STEPHENS COUNTY

314 000 FEET

1 670 000 FEET

EASTLAND COUNTY

4000 AND 5000-FOOT GRID TICKS

INSET A

(Joins upper right)

1 725 000 FEET

314000 FEET

(Joins inset B, lower left)

310 000 FEET

1 700 000 FEET

EASTLAND COUNTY

ERATH COUNTY

4000 AND 5000-FOOT GRID TICKS

(Joins sheet 47)

INSET B

1 755 000 FEET

(Joins inset A, upper right)

310 000 FEET

1 730 000 FEET

ERATH COUNTY

4000 AND 5000-FOOT GRID TICKS

(Joins sheet 46)

(Joins sheet 51)

Tucker Lake

Russell Creek

Gilmore Creek

Edwards Branch

Palo Pinto Creek

South Fork

Turkey Creek

Italian Hill

Coal Mine Mountain

Gibson Creek

Shale Pit Hill

Warter Mountain

Round Top Mountain

Barton Creek

Bridges Branch

Dealton Mountain

Little Sunday Creek

PALO PINTO COUNTY, TEXAS — SHEET NUMBER 51

51

N

(Joins inset, sheet 1)

1 820 000 FEET

313000 FEET

(Joins inset A, lower right)

HOOD COUNTY

Kickapoo Creek

Dry Branch

ERATH COUNTY

1 845 000 FEET

308000 FEET

INSET A

1 790 000 FEET

313000 FEET

(Joins inset B, lower right)

Brush Creek

Double Mountain

Double Mountain

(Joins sheet 49)

(Joins upper left)

309000 FEET

ERATH COUNTY

4000 AND 5000-FOOT GRID TICKS

1 815 000 FEET

INSET B

1 760 000 FEET

314000 FEET

(Joins inset B, sheet 50)

Little Sunday Creek

Blue Flat

Duncan Hollow

Big Sunday Creek

Bear Creek

(Joins sheet 48)

(Joins inset A, upper left)

310 000 FEET

ERATH COUNTY

4000 AND 5000-FOOT GRID TICKS

1 785 000 FEET

2 Miles

10000 Feet

5000

Scale 1:24000

0 1000 2000 3000 4000 5000